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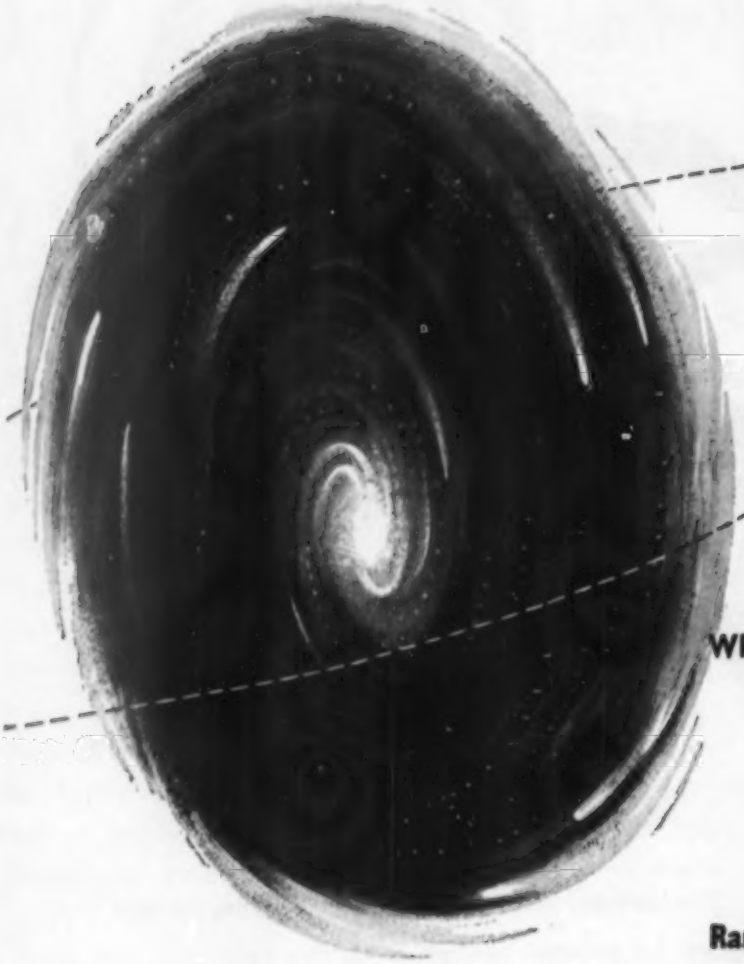

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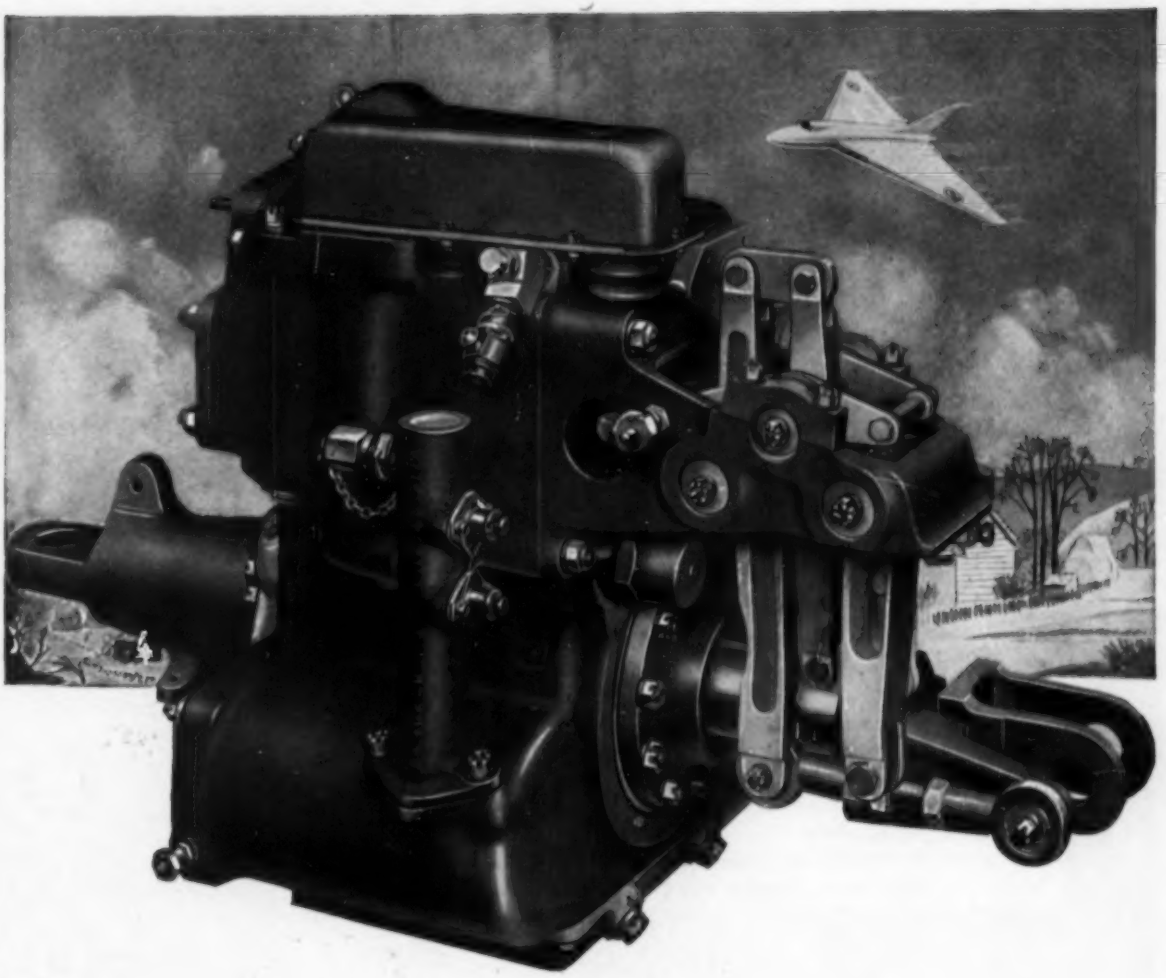

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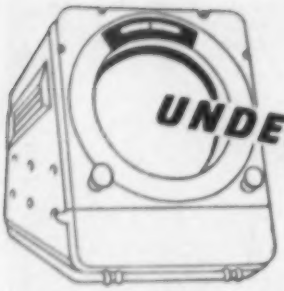

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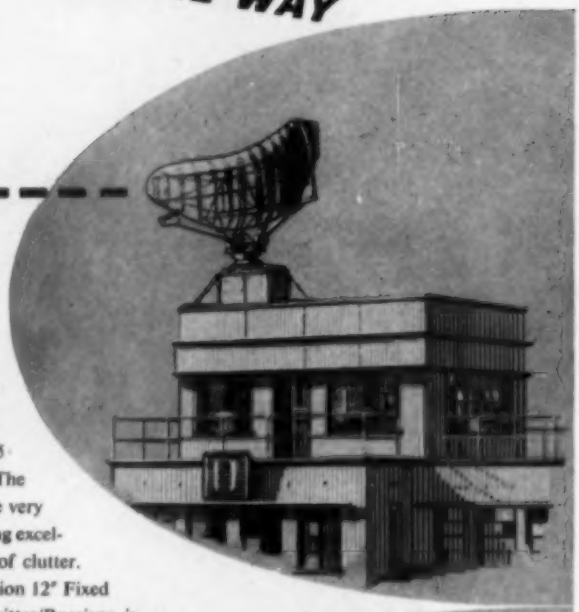

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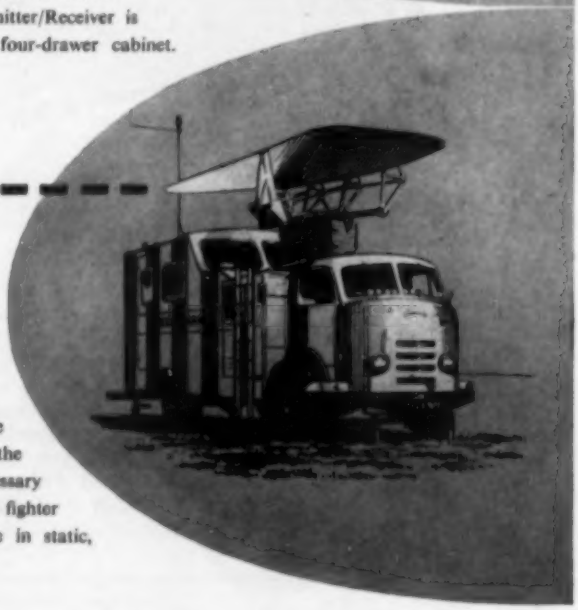

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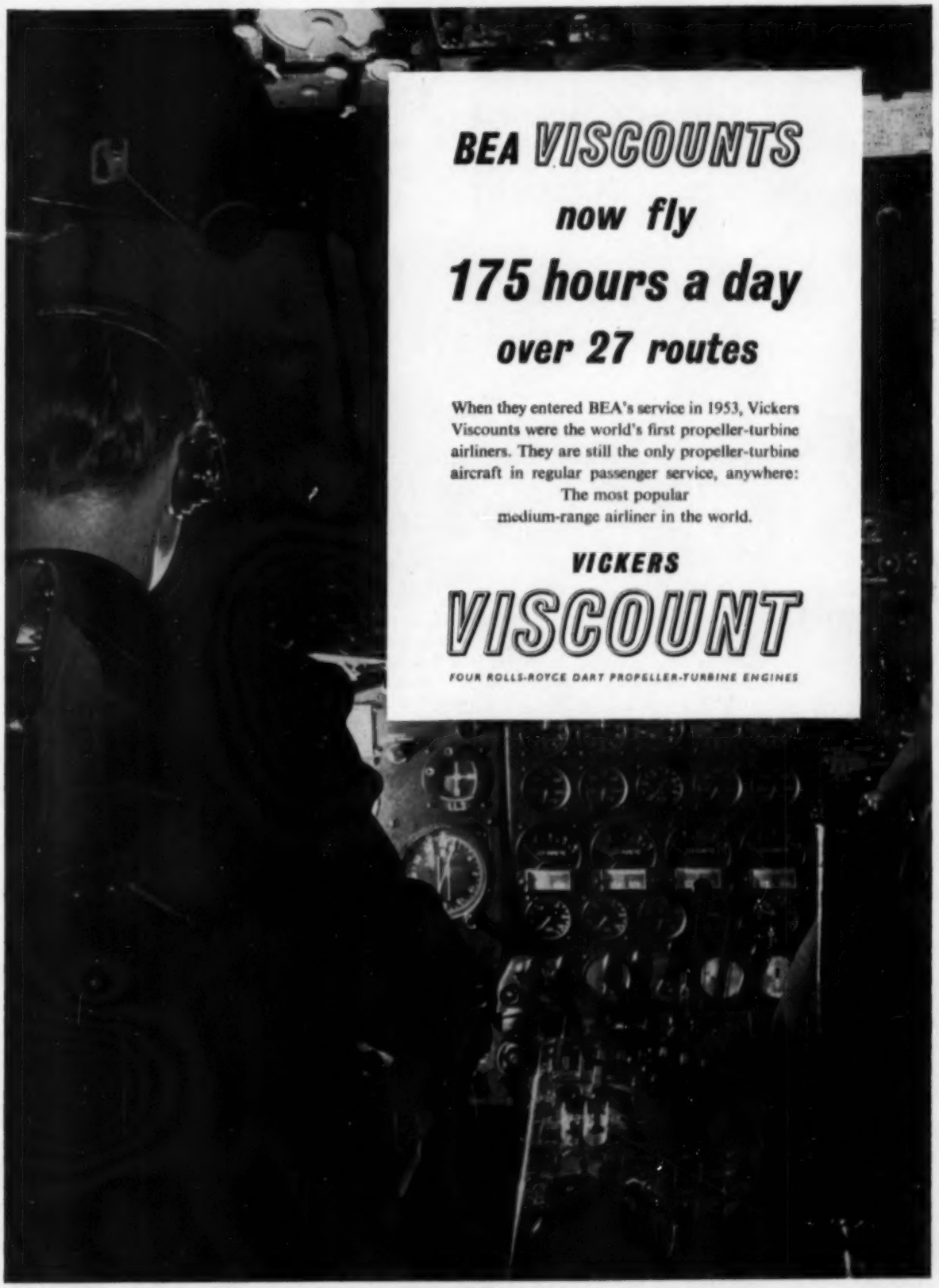

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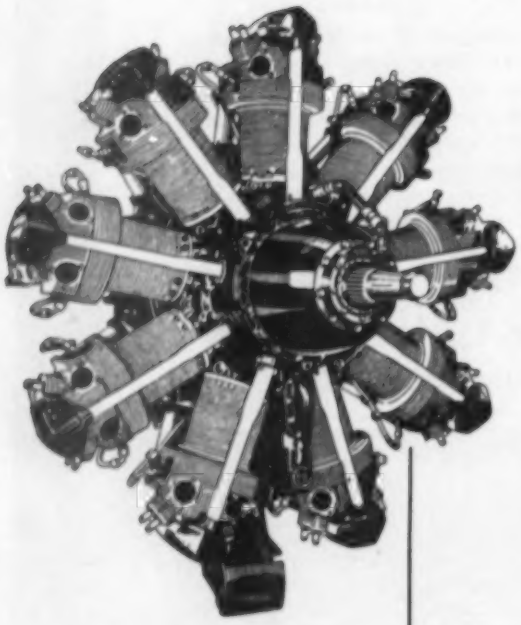

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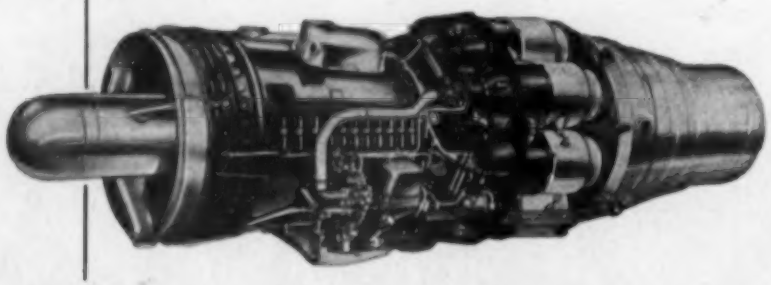

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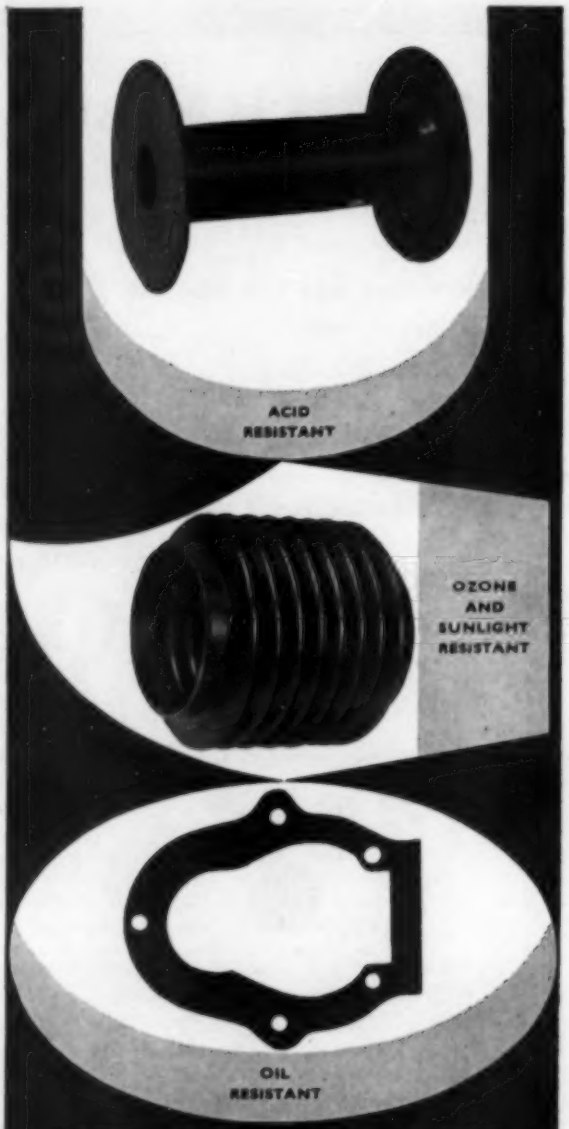

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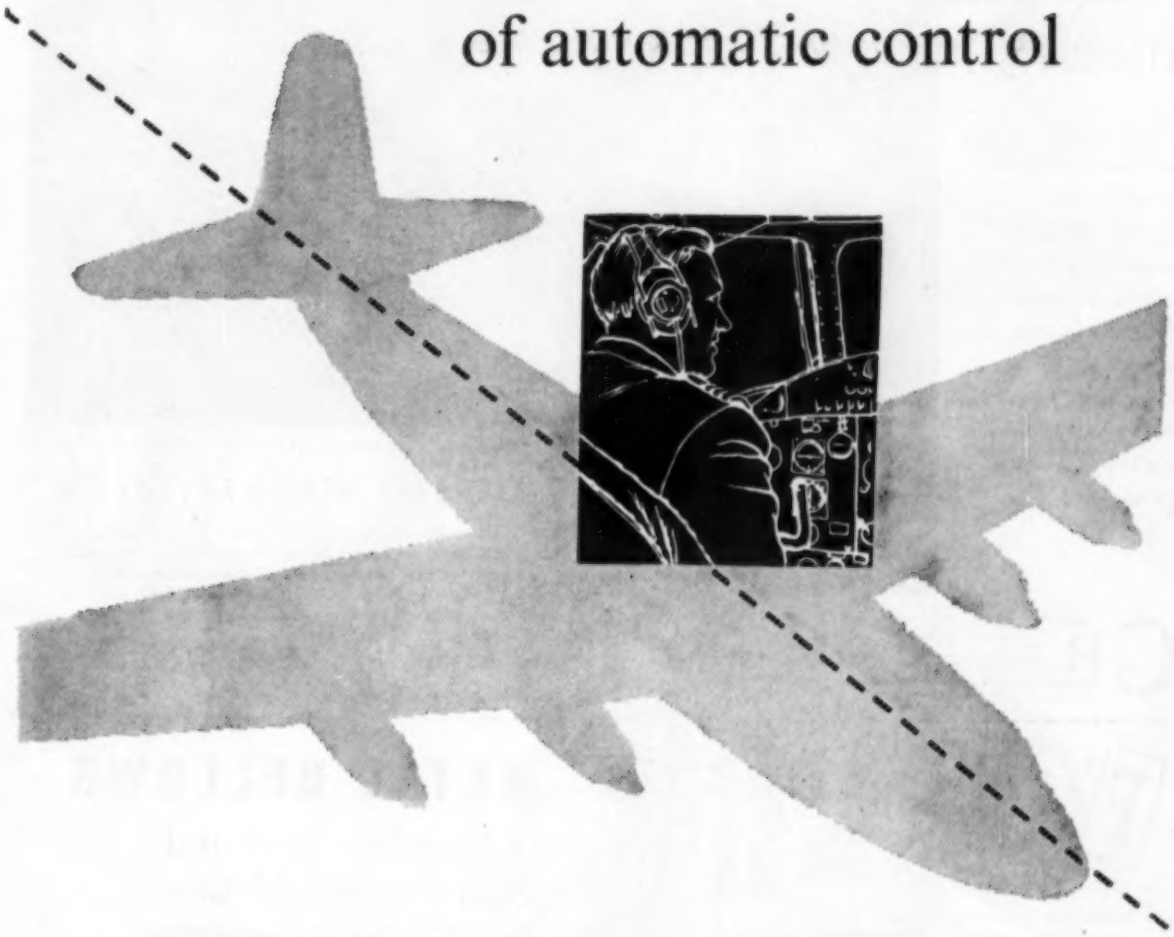

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Marsh Harrier photographed by Eric Hosking. Taken by high-speed flash with a specially constructed set giving 650 joules with two lamps at an exposure of 1/5,000 sec. at f/4·5.

FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

FLIGHT
and
AIRCRAFT ENGINEER

No 2443 Vol 68 FRIDAY 18 NOVEMBER 1955

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One Hope Dashed—

THE after-taste of the past few days is a commingling of disappointment, relief and expectation—astringent, but not wholly unpalatable. Analysis demands that the bitterness be isolated first, and the essence of it is that a major project, for which Service and civil hopes had been entertained, has been confounded: the V.1000 has been cancelled by the Government.

Here, it was widely—though not unanimously—believed, was the military prototype of a commercial liner which might place us abreast or ahead of the Americans on the blue riband routes, defying the best that Boeing and Douglas could put into the air; wedded, moreover, to a unique British powerplant, the Conway, to which the Americans themselves have lately been paying court. Now the entire project lies in limbo.

Let it be agreed that the V.1000 might not have satisfied in every respect the particular requirements of Transport Command; but, having regard to the vast civil orders still unplaced, the protesting voice of Vickers' G. R. Edwards must be heard attentively, for his technical experience and business acumen are acclaimed by his doughtiest rivals. The gist of his remarks is printed on page 776. Further comment may well await a detailed analysis of the design, and comparison (so far as this is possible) with the big Americans.

—but Others Rising

One hope emerging from the demise of the V.1000 is that the field may now be further cleared for something of more pressing importance, whatever changes of policy requirements or outlook may intervene. Commanding immediate attention are the improved Viscounts, so far developed from the original as to constitute a new class of transport aeroplane. Then the Vanguard—the best, so far as can be foretold, that world operators can hope for in its category.

But the recent official pronouncements (which included the suggestion that we have been spreading our resources too thinly) extend into far broader fields. Most significant, we are at last to have rocket intercepters, or, more specifically, home-defence fighters with turbojets and rockets to ensure the best use of each form of power. Pending air-to-air guided missiles this class must largely assume the defence of these islands. The mixed-power intercepter is a fighter which promises a hitherto unattainable combination of rate and angle of climb, level speed, acceleration, operational ceiling and duration. In developed form its Mach number may exceed 2 by a considerable margin, and it is evident that new operational techniques will have to be evolved for its most effective employment. The pioneer effort of Saunders Roe in constructing the S.R./A1 jet flying-boat fighter is thus rewarded with an assignment of high national importance and uncommon technical interest.

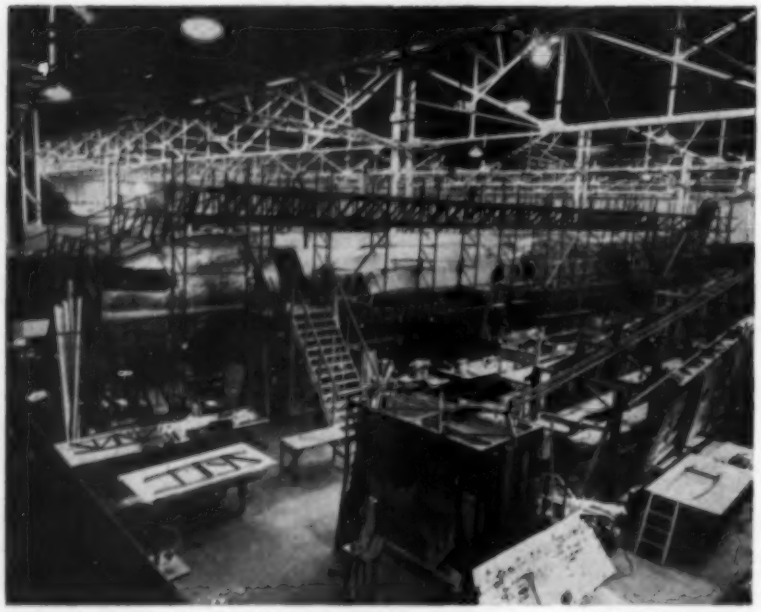
We shall be seeing, too, a new type (if not a new form) of V.T.O. aircraft—a class which literally promises to change the face of the earth. This from Short Brothers, who will thus become Britain's first V.T.O. manufacturers.

There is, too, the assurance that the Hunter intercepter, having emerged from many clouds, is as good a means of knocking down other aircraft as any in the world. And to succeed it there is that dark horse the English Electric P.1. Of more immediate comfort is the official guarantee that all-weather Javelins—incontestably the best of their kind—have practically reached the stage at which they can be issued to the R.A.F.

The news that both the P.1 and the Fairey F.D.2 have passed Mach 1 on the climb is welcome though by no means sensational, for the Super Sabre, of which many hundreds are already flying in the service of the U.S.A.F., has the same capability.

Overall, then, the recent declarations afford firm ground for hope and a certain relief in the knowledge that we are trimming our sails to the wind.

FROM ALL QUARTERS



RELEASED, now that the project has been abandoned by the Government, is this picture of the Vickers-Armstrongs V.1000 military transport under construction at Wisley. It will be seen that the fuselage is almost skinned.

The Duke at Avros

DURING his visit to the Avro factory at Chadderton, Lancs, on November 8th, the Duke of Edinburgh entered the high-altitude test chamber, which at the time was being maintained at a temperature of −60 deg C for a test of Vulcan components. For this phase of his tour he wore a duffle-coat.

In other parts of the factory he was shown various aspects of the company's research and development work, but its nature was kept a close secret even from other members of the official party. The royal visitor was conducted on his tour by Sir Roy Dobson (managing director) and he also had a long discussion with Sir William Scott Farren (technical director) and Mr. J. R. Ewans (chief designer).

After lunch the Duke left for the firm's establishment at Woodford, Cheshire, where he was shown a rig in which was a Vulcan under test. He discussed a number of points with W/C. Roly Falk, chief test pilot. After being presented with a silver model of a Vulcan the Duke left for Northolt, piloting his own Heron.

British Aircraft

IT becomes possible in this issue to refer to several new types of aircraft formerly or currently the subjects of Ministry of Supply contracts. Such details as are available are given in an account on page 776. The principal items of news are as follow:—

Vickers-Armstrongs V.1000 military transport: No further Government support, and consequent cessation of development.

Bristol Britannia 250 LR: Six ordered from Short and Harland to replace the V.1000 programme.

Saunders-Roe SR.53: Supersonic turbojet-plus-rocket interceptor for future R.A.F. service. Prototypes being built at Cowes for early completion.

Avro 720: Unsuccessful competitor of SR.53, to same requirement.

Short PD.11: Vertical-take-off research prototype, being built at Belfast for early completion.

Rolls-Royce Conway by-pass turbojet: Scheduled for trial installation in medium bomber (Vulcan or Victor).

Earth-Satellite Production

IT has been disclosed by Dr. J. Caplan, chairman of the committee of the National Academy of Sciences, which recommended the project, that ten instrumented earth satellites are to be constructed in the U.S.A. It is hoped that at least five or six may be successfully launched in their orbits. The three Armed Services, Dr. Caplan affirmed, are already at work on launching equipment under U.S. Navy management.

It is expected that the satellites will attain a speed of about 18,000 m.p.h., circling the earth in about 1½ hr. When nearest the earth they will be 200-250 miles up and when farthest away 800-900 miles off. If results prove satisfactory they will stay up "for many weeks."

Russia's Turbine Transports

ONE of the first official references to a Soviet jet airliner was made on November 12th by Mr. N. Kruschev, secretary of the Communist Party, speaking informally to reporters during a reception at the Norwegian Embassy in Moscow. Mr. Kruschev said that when he and Marshal Bulganin visited London next year they would travel in a Soviet-built jet airliner, the design of which was based on a medium bomber with a 3,000-mile range.

Some months ago it was reported that Aeroflot were using jet transports for the carriage of newspaper matrices between Moscow and Siberian and Far Eastern cities. It is now known that the type concerned is a modified version of the twin-jet, straight-winged Il-28 bomber—Russia's equivalent of the Canberra. The existence of a twin-jet machine designed specifically as a transport, however, became known at this year's Tushino display.

Reports of a Russian turboprop transport can now be confirmed. Such an aircraft, said to accommodate 100 passengers, has been referred to openly by Soviet officials in London, and one Western observer who has seen it described the machine as "a cross between the Viscount and the Britannia." The design will provide Aeroflot with their first long-range aircraft; introduction on the Moscow-Peking route, it is claimed, will take place next year.

Middle-East Arms Race

BALANCE of power in Arab and non-Arab countries is being closely watched as a result of the rapid acquisition of arms and the atmosphere of mistrust. The air-power situation can be summed up as follows:

Egypt: Agreement reached with France, the latter country lifting its ban on war-exports to Egypt, and apparently ceasing such supplies to Israel. It is widely held—on good authority—that Macchi (Italy) will supply 30 Vampires to Egypt, and that 16 have already been delivered, of which some were destroyed in recent desert clashes. Last Friday the Italian Government refused export licences for these aircraft, and the Macchi firm deny knowledge of the agreement. Also reported is an agreement with Prof. Ernst Heinkel in Stuttgart, whereby "Heinkel jet fighters" will be built in Egypt under German direction. *Israel:* Egyptian sources claim that 36 Dassault Mystères have been delivered to Israel, six having passed through Rome 19 days ago. France and Israel both deny that any have been sent. *Jordan:* Negotiations for supply of British-built Vampires not yet completed. *Lebanon:* Resisting a military alliance with Egypt, and likely to receive arms from Britain.

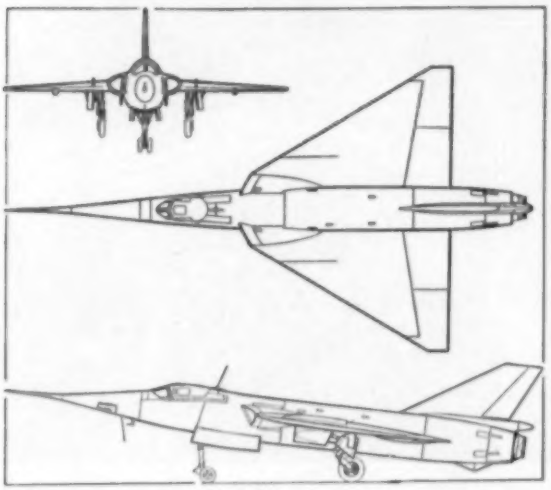
Convair-Canadair Britannia?

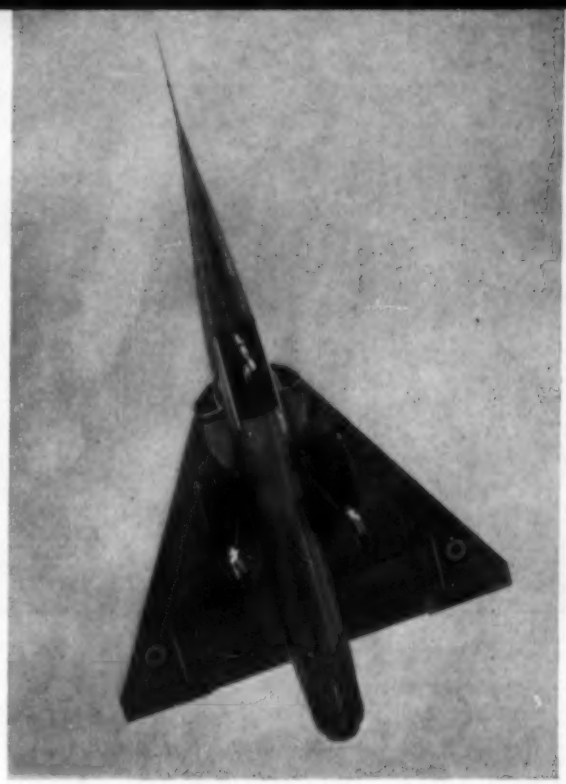
SPECULATION about possible developments of the Britannia (*Flight*, October 21st) was renewed earlier this week by a Canadair statement that the Montreal company might join Bristol and Convair in the production of a 120-passenger, 200,000 lb airliner powered by B.E.25 turboprops, having a cruising speed of 500 m.p.h. and a 5,500-mile range. It was reported that proposed designs for the aircraft would be submitted by each of the three companies at a forthcoming meeting at Montreal and that "once a design is adopted the aircraft will be built by Bristol and another probably by Canadair." The nature of Convair's participation is not clear, although, as they are a sister company of Canadair, it may be assumed that the possibility of design work and production at San Diego have been discussed.

Beverley Build-up

FOR sheer size the Blackburn Beverley is unmatched outside the U.S.A., and (writes a member of the staff who visited Brough last week) the shipyard-like production scene is today one of massive progress. At almost every turn inside the factory loom the burly forms of the first aircraft for R.A.F. Transport Command: nine production Beverleys (XB 259 to 267) have so far flown, the tenth is due to fly shortly, and a further half-dozen may be accounted for in the erecting hall.

Beverleys now have nearly 1,000 hours of flying behind them;





***SUPERSONIC CLIMBER:** The Fairey F.D.2 is one of two types of British aircraft which have demonstrated supersonic speed on the climb (the other being the English Electric P.1). Peter Twiss was the pilot. Characteristics of the design are admirably brought out by the newly released general-arrangement drawing above; but neither this drawing, nor the excellent photograph on the right, can convey the truly "sword-edged" sharpness of the wing trailing edge.*

development work has gone forward steadily to the point where completion of the final major tasks, which include service-acceptance and rôle-equipment trials, are within sight. Cold-weather tests have been allotted to the fourth aircraft, which, bedecked in an Arctic crimson-paint scheme, is due to leave for Canada this month. Current civilian employment—an oilfield airlift—of the second production Beverley was described in last week's issue.

Handley Page Appointment

IT was announced by Handley Page, Ltd., earlier this week that J. W. ("Jock") Still has joined the staff as a test pilot. He is 35 years of age. Mr. Still was educated at Boroughmuir School, Edinburgh, and joined the R.A.F. in 1940. During the following six years he served as a fighter pilot in Britain, North-West Europe, the Middle East and Burma. Flying Spitfires, he took part in "train-busting" raids over occupied Europe and, when serving with No. 1 Sqn., shared in the defence of this country against flying - bomb attacks. After the war he was a member of No. 603 (City of Edinburgh) Sqn., R.Aux.A.F., before joining Brooklands Aviation as a test pilot in 1950. Two years later he went to English Electric in the same capacity. He visited Venezuela in 1953 when that country bought Canberras and saw them into service, and he demonstrated the Canberra at the Farnborough displays of 1954 and 1955. During his fifteen years of flying Jock Still has completed 3,000 hours on fifty types.

J. W. (Jock) Still.

Titanium Fabrication Plant

THE construction of a titanium-fabrication works was announced last week by I.C.I. Work will begin as soon as possible and it is hoped that the new factory, which will cost some £2m and employ about 250 people, will be in production in 1958. The site is near the company's existing light-alloy works in South Wales.

Research and development work by I.C.I. has culminated this year in the commissioning of two large-scale plants for the production of titanium and its alloys. One, built by the company's General Chemicals Division at Wilton in Yorkshire, is concerned with the extraction of metallic titanium and can produce 1,500 tons of the material in a year. The other, at the Kynoch works of the Metals Division in Birmingham, is responsible for melting granular titanium produced at Wilton, and for forging it into slabs and bars for further fabrication.

Some fabrication into wrought forms—sheet, strip, plate, rod, tube and wire—is at present being carried out at Kynoch works and in other Metals Division factories; but, says the company, the demand for fabricated products (particularly sheet, rod and tube for the aircraft industry) is developing so rapidly that the decision has been taken to build the new factory.

Australia's Air Prospects

THE Australian Director-General Elect of Civil Aviation, Mr. Anderson, who takes over his post next January, said in Darwin recently that Comet 4s, Boeing 707s and Douglas DC-8s would be flying into Australia regularly "by 1958"—a date, be it said, which seems improbable. He added that Darwin and Sydney airports would be able to handle these machines satisfactorily, and that navigational aids were sufficient.

It has also been announced in Australia that orders had been placed for an unspecified number of Vampire Trainers and for "two of the latest mark of Canberra jet bombers." The Vampires would be made at the de Havilland factory at Bankstown, Sydney. These orders, according to Mr. Townley, Minister for Air, were placed on the recommendation of the mission which visited Great Britain and the U.S.A. last year to study aircraft development.

The Commonwealth Advisory Aeronautical Research Council Conference at Canberra has been told by the Minister of Supply, Mr. Beale, that Australia leads the world in air-transport usage—16.7 ton-miles per head of population. Next comes the U.S.A., with 15.5 ton-miles; then Canada, with 8 ton-miles.

A. Cdre. Cobby

WE regret to learn of the death, in Melbourne, of A. Cdre. Cobby, C.B.E., D.S.O., D.F.C., G.M., Director of Flying Operations in Australia's Civil Aviation Department. He was 61.

A. Cdre. Cobby joined the Australian Imperial Forces in the First World War, becoming a captain and flight commander in No. 4 Squadron of the Flying Corps. For his brilliant and daring flying he was awarded the D.S.O. and D.F.C. and two bars. After the war he remained in the Service and passed through the R.A.F. Staff College, Andover. He was Director of Recruiting, R.A.A.F., and held high office in the Civil Aviation Board of the Department of Defence.

A. Cdre. Cobby returned to operational duties in the Second World War, directing air operations over New Guinea in 1942-43, and was appointed C.B.E. in recognition of his services. During the last year of the war he commanded the 1st Tactical Air Force of the R.A.A.F., and in 1946 he returned to the Department of Civil Aviation in Australia. In 1944 A. Cdre. Cobby was awarded the George Medal for rescuing three companions from the wreck of a flying-boat off New Guinea.

The everyday scene at Idlewild Airport, New York, which handles more long-haul traffic than any other airport in the world.

LONG-HAULERS FOR SALE

A Review of the Contestants for Air Transport's Most Important Market

NEVER before have the world's buyers of long-haul airliners been courted so devotedly as they are today. No fewer than nine suitors are pressing bewildered airlines for a decision. All of them are decidedly attractive and of good family —they have to be to get even a slight consideration. Some are steady, reliable types—old fashioned but of certain temperament; others are full of modern, progressive ideas, if as yet not fully matured; one or two are even a little roguish in character.

In considering the prospects of each, the airlines choose those they calculate will make the most money. But they do not make their choice simply by drawing a comparison between payload and range, speed and cost-per-ton-mile characteristics, fundamental as these are. So many other considerations are involved in a business as swift-developing as aviation that the decision between one airliner and another is indeed a difficult one to make. In no other form of commerce is the customer's judgement so confused by what he might gain over his competitors by waiting a little longer. Shall he order contemporary equipment now to exploit the mounting traffic, or shall he bide his time in order to invest capital in superior equipment when it materializes? In either course he takes the risk of losing traffic to competitors: the advanced types may succeed in the hands of others, forcing the premature writing-off of a costly new fleet; or they may be delayed, or give endless trouble in service. Feeling that the former risk is the lesser, most airlines are content to stock up with new transports of proven contemporary design, content to let others make the first move in the game of procurement. Hence the manufacturer's dilemma: shall he wait for the security of orders before spending millions on series production, or shall he go ahead and build for the shelf, confident in the soundness of his product?

It has become more and more evident in recent months that the latter course—involving as it does the heavy expenditure of shareholders' capital in a venture that may be late or, at worst, fail—is the one most likely to pay off. Today it is more of a gamble to wait for orders than it is to risk production in expectation of them. But the manufacturer who steers the middle course by offering early delivery to attract the custom he needs for production is heading for trouble. However good his record and experience, he is unwise to allow no margin for delays in the development of a new aircraft which—like a flower—can only reach maturity in a certain time; experienced tending may accelerate its growth, but not beyond a certain point. It may take only one week's flying to perfect—say—the stall, or the de-icing system: it may just as easily take twenty. Yet manufacturers who, allowing for possible setbacks, offer realistic delivery dates are as likely as not to lose business to the apparently more go-ahead competitors.

This is the state of affairs in the long-haul airline business today. Recent events have shown how sensitive to timing is the buying policy of world operators, and how the dangling carrot of early delivery—unreal though it may be—induces a stampede of orders. In the last twenty to thirty days more than a hundred big jet airliners have been ordered for delivery starting early in 1959—the majority for a type which is as yet a wooden mock-up, and all for two aircraft which appear to be astonishingly under-powered.

Three years and a few months is a marginal allowance of time for the development of completely new and complex airliners for public service. Yet the airlines concerned know all this: they are in fact prepared for delays, reckoning that even if these do occur the chances of early delivery are still relatively good.

All this does not imply the wisdom of tempting buyers with impossible production schedules; but it does emphasize the profound effect that the prospect of early delivery has on airlines. To them it stands for more than the opportunity for operating new equipment sooner than others—it is also in a way a reassurance of the manufacturer's competence and ability. Even with aircraft already in production, or just starting to be built, at least six airlines during the past six months appear to have turned down superior products in favour of competitors offering quicker delivery.

These remarks prepare the way for a review of the long-haul airliners on sale today, and the prospects and opportunities for each. To the three great airliner builders of the U.S.A.—Douglas, Lockheed, and Boeing—there are only two challengers, both British—Bristol and de Havilland. The airliners: Douglas DC-7, DC-7C, DC-8; Lockheed 1049G, 1649A; Boeing 707; Bristol Britannia 300 LR; de Havilland Comet 4.

The Douglas claim that more people fly by Douglas than by any other make of airliner is likely to be undisputed for many years to come. More than 2,200 DC-3s, DC-4s, DC-6s and DC-7s are estimated to be in service, and Santa Monica's present monthly output of civil DC-6s and DC-7s is 13 per month. The backlog of orders for the 7, 7B and 7C stands at around the 190 mark, and it is a remarkable fact that 100 DC-6Bs still remain to be completed. Orders for DC-7s are still being steadily placed—for DC-7s are the best transports available for early delivery, excepting only the directly competitive Lockheed L.1049 series of Super Constellations.

Contender for the 1957 airline re-equipment programme, and competing directly with the Britannia 300 LR and the Lockheed L.1649A Super Constellation, is the DC-7C Seven Seas. This great new airliner was designed with one object in view—an ability to fly the Atlantic non-stop every day of the year in either direction. When it comes into service with PanAm in the summer of 1956 it will be the first airliner ever to be capable of performing this feat. It represents a bigger advance over the basic DC-7 than that aircraft did over the DC-6 and, although

designed primarily for a specialist route, it offers piston-engined flexibility and operating cost to challenge competitors on all of the world's main trunk routes. But it represents an ultimate elongation of the 1939 DC-4 fuselage, and its payload capacity far from approaches that of the Britannia. Its chances of adaptation to take turboprop power are vitiated by its wing, and in this respect it does not have the potential of the Lockheed L.1649A. It will not be able to match the Britannia 300 LR operationally, but it will have a clear 18-month lead over that aircraft in airline service, and it is for this reason that B.O.A.C. have ordered ten to maintain their competitive position pending introduction of the Britannia 300 LR. Originally scheduled to fly next spring, the 7C is now expected to begin its trials in a matter of days.

The thought of engineering the DC-7 to take turboprop power certainly occurred to Douglas. Earlier this year the airline world watched the traditional thrust-and-parry between Douglas and Lockheed, wondering just how serious were the turboprop DC-7D, L.1449 and L.1549. The private West Coast game was soon played out, leaving the piston-powered DC-7C and L.1649A at opposing ends of the field. But only in the last few weeks have the two companies made clear their plans for the future.

Douglas have settled for the large 100-seat jet. The DC-8, the biggest commercial venture yet undertaken by the company, has received the encouragement of orders (not, it may be supposed, firm, cash-down contracts as yet) from Pan American (25), United (30), National (6). The DC-8 is the expression of the Douglas belief that the jet airliner has potentially more to offer the passenger and the operator in speed, comfort and operating cost than any other type of airliner. The contention that the jet is costly and inflexible is not borne out by Douglas's figures for the DC-8 compared with the DC-7C. These show that the DC-8 is 40 per cent better than the DC-7C over long stages, and 25 per cent better *down to 500 miles*. Even supposing that these calculations are fifty per cent wishful thinking, there remains little doubt about the effect of such capabilities on the procurement deliberations of the airlines.

The DC-8's 257,000 lb, however, weighs heavily against its immediate chances of world-wide sales—for two reasons. Firstly, a total thrust of between 65,000 lb and 75,000 lb would be needed, even assuming flap-blowing and exceptionally low cruising drag. The requisite engine, say of 18,000 lb thrust, is not in sight of being available, at any rate for public operation, within the three-year schedule Douglas have allowed themselves. The Pratt and Whitney J75 (JT4) is flying in the company's B-45, and has been delivering 15,000 lb on the test-bed; but, although it is a highly efficient engine with a reasonable development capacity, it will be hard-pressed to provide the power needed for DC-8 operation with the reliability and economy expected of a transport engine. Use of the 11,000 lb P. and W. J57 (JT3) for the domestic DC-8 (211,000 lb) is so unrealistic as a commercial proposition, even with water injection, that one assumes the existence of a very much more powerful, security-restricted development of that fine engine. Secondly, there are not many airports in the world whose runways have the length and strength to handle airliners of DC-8 weight, nor do the majority of world operators yet require airliners of such capacity and range.

Sales of the 1049 series of Super Constellations, like those of the DC-7, continue unabated. Orders for 53 are on the Lockheed books at the present date, 113 having been delivered. It is, however, on the L.1649A that Lockheed's future as a long-haul supplier depends. Like the 7C, which is directly comparable with it commercially (although not in development-potential), it is intended for non-stop Atlantic operations. The suffix "A" anticipates interesting developments of this new, thin-winged Super Constellation. The wing—of no less than 150 ft span—has been designed for 500 m.p.h. cruising speeds, and, needless to say, engineered to take turboprops. The chances are that design of an entirely new fuselage, of Britannia-like capacity, is already under way, and one can foresee the evolution of a turboprop L.1649 of 450-500 m.p.h. and enormous payload capacity—a direct competitor of the B.E.25-powered Britannia development.

Progress with the L.1649A is reported to be ahead of schedule, and first deliveries to Air France (12) and T.W.A. (24) are likely to begin in the autumn of 1956.

The Electra, although not primarily a long-hauler, is witness to the conviction shared by Lockheed, Bristol, Vickers and now, it appears, Canadair and Convair, that big business lies ahead for suppliers of turboprop airliners.

The Boeing 707 Stratoliner, the prototype of which has been flying since July 1954, is more likely than the DC-8 to enter service by the scheduled time—mid-1959. It is on order so far for Pan American (20), and American (30), and its production is comfortably supported by an order for 250 of the KC-135 tanker version for the U.S.A.F. Like the DC-8, which closely resembles it in size and performance (and incidentally in appearance) it is likely to suffer from a deficiency in power, and the same limitations as to world-wide application. The fact, however, that both Boeing and Douglas must have calculated on selling at least 150 aircraft each—representing 60 per cent of the *total* present ton-mile capacity of the world's long-haul airliners—is likely to give pause to those who have been viewing the future through turboprop spectacles.

The Bristol Britannia 300 LR has been called the world's most wanted airliner. It has more to offer the operator in terms of size, speed, range and comfort than any transport yet designed. Because it is entirely new, however, its full opportunity for world-wide sales are unlikely to be realized until its predecessor, the Britannia 100, has proved itself in service, which will not be until 1957. By then deliveries to the first 300 LR customers—B.O.A.C., El Al, C.P.A.L., and others currently on the point of ordering, will be taking place; but the Britannia exemplifies the dilemma confronting every new airliner—production only with orders, orders only for early delivery, early delivery only with production. One point is certain: the promised commercial capabilities of the 300 LR have already set a standard by which every other airliner is measured, and if business should from time to time pass to competitors such as the DC-7C and L.1649A it will not be for any operational shortcomings in the Britannia.

One important feature of the aircraft, which has never received the credit it deserves, is the size of its fuselage. 1955 has been the year of the burly-bodied airliner—Vanguard, DC-8 and Stratoliner being examples. It has been learnt that nothing contributes more to the commercial success of an airliner or fixes its potential development more than the capacity of its interior. The diameter of the Britannia's fuselage (144in), decided on by Bristol in 1947, compares with that of the biggest so far visualized, the 147in of the DC-8.

As for future developments of the Britannia, it seems certain that thin wings and B.E. 25 power will put it in the 500 m.p.h. regime; and—as reported on an earlier page—Bristol are looking intently even further into the transport future.

The de Havilland Comet 4 is before all else an airliner for the world market, and not primarily designed—like the DC-8 and the Boeing 707—around the requirements of a few routes of particular U.S. interest. The de Havilland belief is that the new Comet will offer on every world route of 1,000 to 3,000 miles better schedules and a higher standard of service than its competitors and for a comparable operating cost. These claims do not appear unjustified when it is realized that the Comet 4 is potentially *twice* the ton-mile producer than was the Comet 1—an aircraft which yet more than held its own competitively and economically while it was in service.

Unlike the DC-8 and the 707, the Comet 4 is certain to fit naturally into the general air route pattern of the world, leaving the very long 3,000-mile-plus routes to be fought for by the bigger jets and the wider-ranging turbo-props. There seems little doubt today about the rôle of the jet in air transport, and particularly the leading part that a medium-sized unit can play in it. With its plentiful power, superbly engineered and relentlessly tested structure, the Comet 4 can, if produced in numbers in time, have a marked effect on the future course of air transport.

J. M. R.

QUENTIN REEVES—A POSTSCRIPT

COLLEAGUES of the late Hugh Quentin Reeves—who, as recorded in our issue of November 4th, was killed whilst testing a turbojet ground-running pen of his own design—have lately written tributes in which is revealed something more of the scope of his war-time activities. By its nature his work at that time was cloaked in secrecy, and it is only now that a few details have emerged.

When war came he served with the Second Division B.E.F., was promoted major within twelve months and eventually lieutenant-colonel. After Dunkirk he was attached to the Inter-Services Research Bureau, a department concerned with the design of secret equipment for the various forces and organizations generally known as the Special Services.

From then onwards he applied himself with enthusiasm, and often at great personal risk, to a variety of projects. He was one of Britain's first frogmen; he was also the inventor of a motorized submersible canoe. Guns of special design, used by British and Allied agents and saboteurs, were also products of his fertile brain. Other Quentin Reeves inventions concerned gun-silencers (this work was later to lead to his interest in jet-silencing), high-altitude helmets, and special chocks for jet aircraft. After demobilization he started his private practice as an engineering consultant, numbering among his clients some of the most famous firms in the country.

"Inefficiency was anathema to him," writes one of his friends, "and he was no respecter of persons when administrative delays or incompetence endangered the lives of his men or the success of his plans. The penetrating brilliance of his mind was matched by his determination and persistence. Perfection was his standard, and in trying to achieve it in everything he undertook he never spared himself."

HERE AND THERE

DEFENSIVE GAGGLE: The four principal types employed by Air Defense Command, U.S.A.F. In the lead is the Lockheed RC-121D radar picket, of the type which patrols the Atlantic and Pacific coasts; at upper left, the Lockheed F-94C Starfire; lower left, North American F-86D Sabre; right, Northrop F-89D Scorpion. All three fighters are rocket-armed.

Another Britannia

G-ANBD, fourth production Britannia 100, made its first flight at Filton on Monday last, November 14th. Piloted by "Bill" Pegg, it was airborne for 90 minutes.

Javelin FAW.2

A RECENT announcement concerning Gloster Javelin Mks FAW.4 and FAW.7 (*Flight*, November 4th) is now followed by an official reference to the Javelin FAW.2. Externally identical with the FAW.1, this mark differs only in equipment.

N.A.E. into R.A.E.

THE National Aeronautical Establishment at Bedford, announces the Ministry of Supply, is to be known after December 1st as the Royal Aircraft Establishment, Bedford.

Bristol Zeus Reported

THE following is a rough translation, from the Italian, of a recent paragraph in *Alata*: "People in industrial circles are speaking of a new Bristol turbojet with the name Zeus. This engine is to have an expected rating of 9,000 kg (19,200 lb) thrust."

C.P.A.L. and the Comet 4

IT is understood that Mr. W. G. Grant McConachie, president of Canadian Pacific Air Lines, is to visit Hatfield in the near future to discuss Comet 4s. Mr. McConachie was quoted as saying at the time of signing a contract for Britannia 300 LRs that C.P.A.L. were still "very interested" in the Comet 4. A subsequent statement, issued by C.P.A.L. in London on November 7th, described the Britannia order as having been placed "because of the rather indefinite delivery date and probable time which must necessarily elapse before the Comet 4 is available."

Full House

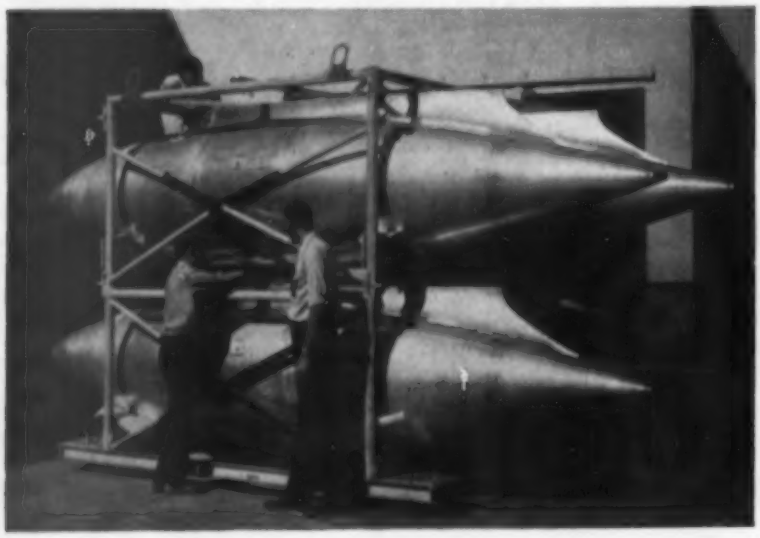
THE Pathfinder Association states that tickets for its ball at the Dorchester Hotel on December 3rd are sold out.

R.Ae.C. Film Show

THE first of the winter-season film shows for Royal Aero Club members and their guests takes place at Londonderry House next Thursday, November 24th, at 6.15 p.m. Four films will be shown: *The Seamew* (Short Bros. and Harland, Ltd.); *Spotlight on the Flying Sailors; The Fighter Pilot* (Royal Swedish Air Force); and *Turbojet Propulsion* (Rolls-Royce, Ltd.).

Area-ruled Sabre

LAST week it was announced in Montreal that the Canadian National Aeronautical Establishment has area-ruled a Canadair Sabre [an article on area rule appears on pp. 769-771]. The modified aircraft has a revised top-line to the fuselage, the dorsal surface being depressed from the leading edge of the wing (at the root) to a point near the tail. This is the first time that area rule has been applied to an existing design in this manner; previously (F11F and F-102) the "nipping-in" has been on the sides. No details of the flight performance of this Sabre are available. Testing is continuing at Uplands Airport, Ottawa.



The Strikes Continue

EXECUTIVES of nine unions concerned in the nine-week-old strike at Hawker's Blackpool works were meeting last Tuesday to discuss a resolution calling for "positive action" in all 13 factories of the Hawker Siddeley Group. Also continuing, and entering its third week, was the strike of 7,500 employees at three Rolls-Royce engine plants in Scotland. Both strikes are unofficial, but the unions have been observing them closely.

Dutch Helicopter Firm

IT was announced recently that N.V. Kromhout Motoren Fabriek D. Goedkoop Jr. of Amsterdam, and the N.V. Maatschappij Vlietuigebouw Aviolanda of Papendrecht, South Holland, have jointly established, at Rotterdam, a new concern named Nederlandsche Helicopter Industrie N.V., with a nominal capital of 500,000 guilders. Its purpose is "to develop, repair and do business in helicopters." The new company will build the Dutch-designed Sobeh 1 helicopter, experiments with which have been going on for some time.

Japanese Jet

TOKYO RADIO reported last week that the JO-1, the first home-produced Japanese turbojet, had successfully started running trials. Development of this engine started in April 1952, and Fuji Heavy Industries and the Japan Jet Engine Company have since spent 75m yen (£75,000) in government grants in bringing the project to the running stage. The engine is a 2,200lb-thrust axial, with a simple compressor and tubular combustion-chambers. The prototype was illustrated in *Flight* on September 3rd, 1954, and a full background to its development was published in our review of the Japanese aircraft industry on April 1st, 1955. It is also reported that a small turbojet for trainers is being developed. Designated J-3, this design is believed to be of Continental-Turboméca origin.

TANKS FOR TANKERS: These Ryan-built external fuel tanks—each with a transfer capacity of 583 Imp. gal—are for Boeing KC-97G tankers of the U.S.A.F.

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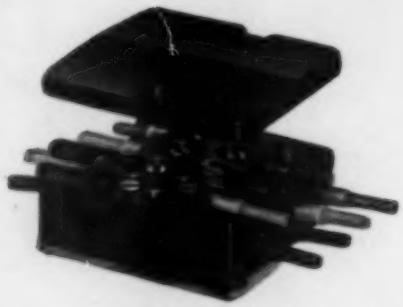
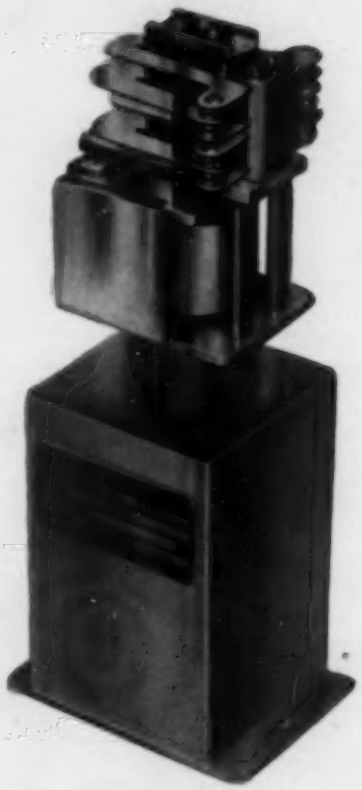
Plessey publication 712, containing complete details, diagrams and tables, is available free to manufacturers—see that your Design Engineers have a copy.





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A British Approach to the Area Rule

—*and Transonic Design Considerations*

By W. T. LORD

MANY readers will remember the outline of the so-called "Area Rule" for transonic design, published in our issue of September 30th last. That article was based upon recently published American work in this important field; and, to add a contribution from Great Britain, we are glad to publish this summary of design parameters considered mainly at the Royal Aircraft Establishment, Farnborough. The author is a member of the Supersonics Division of the R.A.E. Aerodynamics Department.

IN recent weeks some publicity has been given to a new method of designing transonic aircraft, known as the area rule. The impression conveyed by the information so far published has been that the area rule was a purely American discovery, and that acceptance of its important applications has been confined to the U.S.A. Although the major credit for the area rule must undoubtedly go to the Americans, and to R. T. Whitcomb (N.A.C.A.) in particular, for the energetic experimental investigations without which such a simple and general rule would seem unconvincing, quite significant contributions to its development have been made in Britain (and also in Sweden and in France). It is hoped to give in this short article an outline of the work which originated at the Royal Aircraft Establishment before news of the American work arrived, and which has progressed since with an enthusiasm continually stimulated by communications from the U.S.A. [This transfer of information is referred to on page 771—Ed.]

The work described here is distinct from, but by no means contradictory to, that of D. Küchemann, who, since several years before the area rule was established, has been developing another method of transonic design which has had an important influence on current British aircraft. It is highly likely that, when a full understanding of transonic flows is achieved, the two methods will be found to be complementary.

The approach to the area rule has been primarily theoretical. Probably, theoretical is a description which implies more mathematical rigour than did, in fact, exist in the arguments by which the area rule was deduced here. Therefore, it was vital to seek experimental confirmation of the conclusions drawn from those arguments. Although some completely successful free-flight tests have been performed at the Royal Aircraft Establishment to confirm the area rule in a special case, confidence in British theoretical predictions has been obtained mostly from studies of American experimental results.

However, reliance on the extraordinarily compact theory behind the area rule has some advantages over a solely experimental approach. The effects of a number of variables can be examined quickly, and, although theoretical estimates do not carry as much conviction as experimental results for transonic speeds, they do, nevertheless, indicate the correct trends which are the foundations of detailed knowledge.

To understand the area rule, it is necessary to be familiar with one of the main features of transonic flight: the sudden rise in the drag of an aircraft as the aircraft attempts to fly faster than the speed of sound. The drag of an aircraft consists of many components, and the sudden drag-rise starting at a speed just below sonic speed is caused by the onset of shock waves which produce a new component of drag called "wave drag." The initial rate at which wave drag increases can be so rapid that, if the aircraft has only a narrow margin between thrust and drag at the speed at which shock waves first appear, then it will be unable to fly much faster than that speed. This fact is illustrated in Fig. 1, which contains a graph of thrust coefficient and drag coefficient plotted against Mach number M for a hypothetical aircraft at zero lift. The aircraft might be similar in plan view to that shown in Fig. 2. The highest Mach number attained by this aircraft would be about $M = 0.95$.

The transonic speed range presents exceptionally complicated aerodynamic problems, both experimental and theoretical. Experiments in transonic wind tunnels are difficult to perform and the flows which must be investigated are a mixture of subsonic and supersonic flows. Theoretical investigations encounter the difficulties inherent in the solution of non-linear differential equations. There are, however, two simple results which are useful in an introduction to the area rule. Firstly, the flow through a stream tube of small surface slope in the stream direction depends only on the variation of the area of the stream tube in cross-sections perpendicular to the stream, and the minimum cross-sectional area of such a stream tube occurs where the speed is sonic. Secondly, in regions where the speed is sonic, small disturbances tend to be propagated in planes perpendicular to the stream direction. Both these results are deduced from very simplified theories which may not be validly applied to the transonic flow past an aircraft, but they do help in visualizing how the wave drag rise of an aircraft depends on its shape. The drag-rise coefficient of the hypothetical aircraft referred to in Fig. 1, and depicted in Fig. 2, is shown separate from the other component drag coefficients in Fig. 3.

If an aircraft is such that the ratio, say, of the span of its wing to the length of its fuselage is small, then, provided the wing has some sweepback or taper, it may with some justification be described as a slender aircraft. If the aircraft is flying at a supersonic Mach number M, its wave drag may be estimated roughly by concentrating on a slender stream tube which completely encloses the aircraft. The importance of the area distribution in the flow through a slender stream tube then suggests that such an overall property as the wave drag of a slender aircraft at a supersonic Mach number may depend predominantly on its own cross-sectional area distribution.

This is indeed true if the slender aircraft is also smooth in the sense that, if its area distribution is denoted by $S(x)$ *for* $0 \leq x \leq l$, where x is the distance measured from the nose of the aircraft and l is the length of the aircraft, then the slope $S'(x)$ of the area distribution is continuous along the length of the aircraft and is such that $S'(0) = 0 = S'(l)$.

Conventional aircraft: thrust and drag coefficients, plan view and drag-rise coefficient.

Fig. 1.

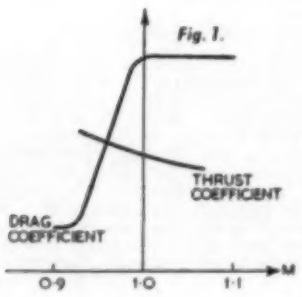


Fig. 2.

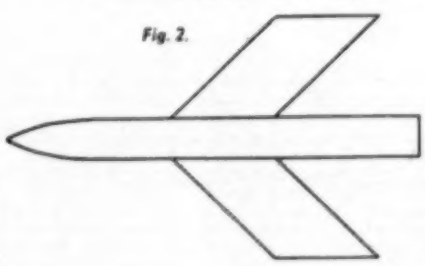
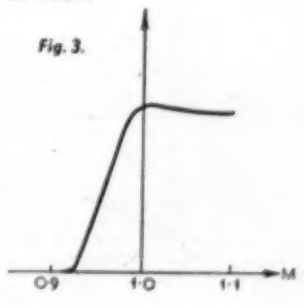
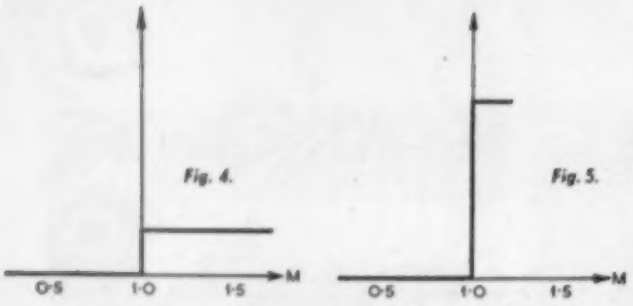


Fig. 3.





Approximation to drag rise coefficients for slender (left) and not-so-slender aircraft.

A BRITISH APPROACH TO THE AREA RULE . . .

In this case a rigorous mathematical treatment of the problem using a linearized theory, based on the fundamental work of G. N. Ward, shows that the wave drag D is given by the formula:—

$$\frac{D}{q} = \frac{1}{2\pi} \int_0^l \int_0^l S''(x_1)\, S''(x_2) \log \left(\frac{l}{x_1 - x_2} \right) dx_1\, dx_2, \qquad (1)$$

where q is the kinetic pressure for a Mach number M.

Now this is a formula for the wave drag of a smooth, slender aircraft flying at a supersonic Mach number. It is an extraordinarily simple and general formula, because it shows that the wave drag coefficient depends only on the cross-sectional area distribution, and is independent of the cross-sectional shape and the Mach number. Since the wave drag coefficient is zero at a subsonic Mach number, and is thus independent of Mach number also, it seems reasonable to suggest that an approximation to the variation of the wave drag coefficient of a smooth slender aircraft through the transonic range may be obtained by continuing the constant subsonic and supersonic values to M=1, where the wave drag is assumed to change discontinuously. This approximation is illustrated in Fig. 4.

There is another important property of formula (1). The theory from which it is derived assumes not simply that δ is small but that $\delta\sqrt{M^2-1}$ is small. Therefore, near M=1, formula (1) may still contain some truth for aircraft which are not-so-slender. The perpendicular propagation of small disturbances at sonic speed is an aid in accepting this possibility. However, formula (1) will cease to be true at a Mach number correspondingly lower than that for a slender aircraft, as indicated in Fig. 5.

Thus the restriction of slenderness may be removed for transonic speeds, and not surprisingly the restriction of smoothness is often removed also, although the justification for this is merely intuitive.

If the aircraft is not sufficiently smooth, in the sense just defined, then formula (1) should not be used to estimate the drag rise, and there is no alternative formula. If the aircraft is smooth, then formula (1) may be used to predict the drag rise, but the value it yields requires some interpretation. Its absolute value may have only a vague quantitative significance, but its ratio to the corresponding value for another smooth aircraft is considered to give a quite reliable comparison of the drag rise characteristics of the two aircraft near M=1, and may be thought of as the ratio of the wave drags of the two aircraft at M=1. This interpretation is particularly useful when an experimental result for one aircraft is available, for then an estimate of the likely experimental result for the other may be deduced by identifying the experimental value of the ratio of the wave drags at M=1 to the theoretical value estimated by formula (1). Moreover, in many cases the drag-rise ratio is a guide to the Mach number at which the drag rise starts, a lower drag rise often implying a delayed drag rise.

So far the discussion has considered only the problem of the estimation of the drag rise of a specified aircraft, or, more accurately, the comparison of the drag rises of two aircraft which are comparable in the sense that they both satisfy a certain set of design conditions. But such a comparison leads naturally to a conclusion that one aircraft has a lower drag rise than another. An immediate consequence of such a conclusion is the question: how can the comparable aircraft with the lowest drag rise be designed? Since the drag rise of each aircraft depends only on its area distribution according to formula (1), the answer to this question is: by choosing its area distribution to be such that the drag rise given by formula (1) is a minimum under the specified set of conditions. The area distribution which gives the minimum wave

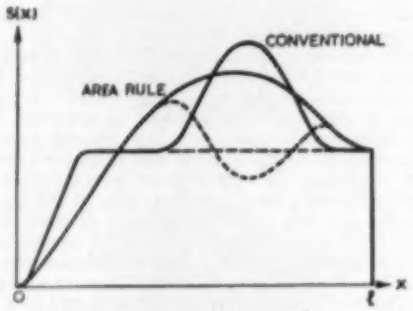
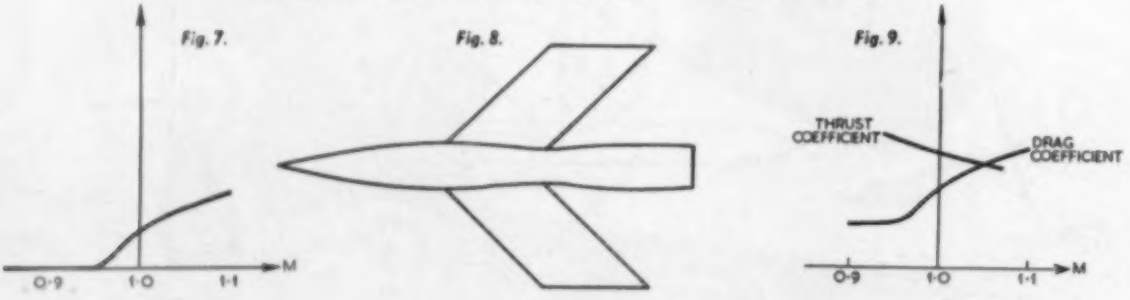


Fig. 6. Area distributions of conventional and area rule aircraft.

drag rise under a certain set of conditions is called the optimum area distribution for those conditions. Optimum area distributions, and, of great importance, the wave drags associated with them, are known for a wide variety of conditions. Particularly valuable are those which have been derived and employed at the Royal Aircraft Establishment by E. Eminton.

Thus, formula (1) excites interest in two problems: the derivation of the optimum area distribution for an aircraft to have minimum drag rise under certain specified conditions, and the numerical evaluation of the double integral for the area distribution of a specified aircraft. These apparently distinct problems have previously been treated separately, but now E. Eminton has used the solution of the former problem as the basis of a practical method of solving the latter problem. Since it is often desired to fix some cross-sectional areas intermediate between the nose and the base of an aircraft, optimum

Area rule aircraft: drag-rise coefficient, plan view and thrust and drag coefficient.



area distributions which have an arbitrary number n of intermediate areas fixed have been derived. Now, if n is not greater than about four, say, the wave drag associated with the appropriate optimum area distribution may still be appreciably lower than the wave drag associated with the area distribution of a fully specified aircraft which has the same n intermediate areas. But when n becomes greater than about ten, say, and the fixed areas are fairly regularly spaced, the optimum area distribution ceases to produce a significant reduction in wave drag, and therefore begins to provide an approximation to the wave drag associated with a fully specified area distribution. Thus there follows a method of numerical evaluation of the double integral, and this method has proved to be ideal for an electronic computor, such as the DEUCE at the Royal Aircraft Establishment. Moreover, when only one or two integrals are to be evaluated the method is not unduly tedious with a desk computor.

The most significant deduction from the area rule is the intimate inter-dependence at transonic speeds of all the parts of an aircraft, especially the wing and the fuselage. Hitherto, the estimation of the wave drag of an aircraft has consisted of finding the sum of the wave drags of all the separate aircraft parts, since there was no reliable guide to the allowance to be made for interference drag. The concept of a moderate unfavourable miscellaneous drag, including interference effects, is quite inadequate at transonic speeds, since the interference drag can be fantastically favourable, and may dominate the drag rise. Thus, attention should be fixed at first on the whole aircraft and not on its component parts separately. When the overall character of the aircraft is correct, so the area distribution is optimum, then the design of the components must be considered in detail.

Examples of the sometimes sensational reductions in drag rise which the area rule offers can be constructed by assuming, for simplicity, that an aircraft may be considered as a combination of a wing and a fuselage. Then, a common design problem is: given, from considerations other than those of wave drag, the wing and its location on the fuselage, and given certain specified requirements of the fuselage, design the fuselage so that the wing/fuselage combination has the minimum drag rise. This is achieved by making the area distribution of the combination the appropriate optimum area distribution, and therefore by making the area distribution of the fuselage equal to the difference between the optimum combination area distribution and the area distribution of the exposed part of the wing. The cross-sectional shape of the fuselage is still arbitrary, of course, and its choice is connected with the careful detailed design of the local regions of the aircraft.

A quantitative example, which is not in any way exceptional, can be based on the hypothetical aircraft depicted in Fig. 2; the aspect ratio of the exposed part of the wing is 2, the sweepback is 45 deg and the thickness/chord ratio is about 0.07, say, and the thickness/length ratio of the fuselage is 0.10. The interference wave drag at $M=1$ is negligible for this aircraft, because the body is cylindrical forward of, and throughout the region of, the wing. If the wing and its location are considered to be fixed, and the specified conditions on the fuselage are taken to be the length, the base area and the volume (so that no stowage space is lost) then a new fuselage may be designed in such a way that the area distribution of the resulting combination is the optimum for the given length, base area and total—that is, wing-plus-fuselage—volume. The area distributions of the old and the new aircraft are shown in Fig. 6. Theoretically it is predicted that for the new aircraft the interference wave drag at $M=1$ is so favourable that it removes the whole of the wing wave drag and a half of the wave drag of the old fuselage, so that the wave drag at $M=1$ of the new aircraft is about a quarter of the wave drag at $M=1$ of the old aircraft. Experiments show that through the transonic range the wave drag of the new aircraft varies in a fashion similar to that shown in Fig. 7. The fact that the wave drag coefficient is increasing at $M=1.1$ is a warning that design for low wave drag at $M=1$ may not produce less wave drag at supersonic speeds, for which another design may be necessary. If the new fuselage is chosen to be a body of revolution, then the new aircraft is similar to that illustrated in Fig. 8. Furthermore, if the thrust of the new aircraft is the same as that of the old, the graph of thrust coefficient and drag coefficient against Mach number in Fig. 9 shows that the highest Mach number attained by the area rule aircraft is about $M=1.05$, an increase of 10 per cent over that of the conventional aircraft. Of course, the increase in top speed is very sensitive to changes in thrust as well as drag, and is therefore very dependent on the peculiarities of a particular aircraft.

This example gives some idea of the effects of using the area rule to design a transonic aircraft, and, in this case, the fuselage of the aircraft has a definite waistline. However, it is not true that the fuselage of an aircraft designed to the area rule must necessarily have an exaggerated waist. Indeed, an exaggerated waist often implies an unwise choice of wing or wing location, or too stringent restrictions on the fuselage. Modifications to the fuselage of an existing aircraft may result in a pronounced waist, but design with full application of the area rule throughout may quite easily produce an unremarkable fuselage shape. This is so, for instance, when the wing root is thick and fairs smoothly into the fuselage. Generally, therefore, sensational fuselage shapes indicate that there was need for great improvement.

The simplicity and generality of the area rule have the consequence that its implications and applications are very extensive, and thus cannot be adequately described in a short article. Nevertheless, it is hoped that this introduction to the area rule is sufficient to demonstrate its importance as a first stage in the design of transonic aircraft. There are limitations to the area rule, and certainly the rule does not eliminate the need for great care in the detailed design of the component parts of an aircraft; for instance, the possible effects of fuselage shaping on the boundary layer must always be considered. But it does seem that an aircraft designed without regard to the area rule is unlikely to achieve maximum transonic performance, no matter how carefully its component parts may be designed.

BRITISH AREA RULE

IN reply to a question asked in the House of Commons, the Minister of Supply, Mr. Reginald Maudling recently made the first pronouncement on British use of the area rule—the rule-of-thumb law for transonic design which we described on September 30th and which is also the subject of the article above.

He said "A report on the area rule was released to us by the Americans in January 1953, and circulated by my department to all designers of British military aircraft. . . . All current British designs have been examined in the light of the new rule but few improvements have resulted, because it is of benefit only in the case of aircraft designed for supersonic speeds and because our supersonic projects have been found already to conform closely to area rule principles."

AIRLINE GOLFERS

A MATCH was played at Wimbledon Park on October 28th between the Foreign Airlines Golfing Society, which comprises representatives of all overseas airlines with offices in this country, and a team representing the British aircraft industry. The foreign airlines, who acted as hosts for the day, defeated the industry. Results of the match were as follows (airlines players mentioned first in each case): Croucher and May beat Sturgeon and Songhurst; De Meer and Lieby lost to Ingham and Langrish-Smith; LeMesurier and Gaunt beat Walsh and Templeman; Adams and Haddam beat Walker and Rowe; Bamford and Rogers beat Howard and Young; Christensen and Bennett lost to Stafford and Campbell; Dingwall and Tapp lost to Waite and Green; Johnson and Laurie beat Sanson and Bamford Jr.

EIRE'S AIRLINE

Aer Lingus—a Brief Survey; Good Progress with Viscounts

EI-AFV "St. Patrick," flagship of the Aer Lingus fleet of four Viscounts, is seen at Dublin Airport, centre of the network. Aer Lingus were the first airline outside England to order Viscounts.

THE past year has been an eventful and satisfying one for Aer Lingus Teoranta, the national airline of Eire. Highlights have included the completion of the first full year of operation by the Viscount fleet (which has logged more than 10,000 hr), the announcement of a profit for the financial year 1954-55 and the recent opening of a new London office.

Compared to the majority of national airlines, Aer Lingus are not a large organization. The company employs some 1,500 people, 150 of whom are aircrew, and operates a fleet of thirteen DC-3s and four V.707 Viscounts which together carried 338,000 passengers, 6,040 short tons of cargo and 1,715 short tons of mail during 1954-55.

The major problem faced by Aer Lingus is the familiar European one of seasonal unbalance of traffic-flow, though in the case of the Irish airline its effects are exceptionally marked. Indeed, the seasonal nature of their traffic compels Aer Lingus to maintain an organization and aircraft fleet nearly twice as large as would be necessary if the same volume of traffic were spread evenly through the year.

The company also has to compete with long-established and well-organized surface transport, and a recent survey showed that only ten per cent of the largest group of passengers originating from the United Kingdom—those visiting relatives in Ireland—travelled to and from Ireland by air. The same survey also showed that travel on the route is by no means confined to the upper-income groups, for it was found that lower-income group passengers comprised over half of the air traffic during the peak period of 1954.

The effects of weekend and summer peaks on traffic-flow are illustrated by the fact that in July 1954 the airline carried 3,423 passengers in one 21 hr period, whereas only 228 passengers were carried on a "trough" day in February of that year.

The airline has revised its fare-structures to encourage mid-week and off-peak-hour travel by the introduction of "Dawn-flights" and "Starflights," but there is no tailor-made solution to the summer-peak difficulties. To some extent, the winter off-season has been countered by increased carriage of cargo and mail, charter flights and by arranging major fleet overhauls in winter.

A factor of great significance was the introduction of the Viscount to the main routes in April 1954. The passenger-appeal of these turboprop aircraft has enhanced the popularity of the "all-Viscount" Dublin-London route—a service second only to the London-Paris route in terms of passenger traffic density. Aer Lingus are very satisfied with the Viscount's performance during the first year of operation. Three Viscounts were used on scheduled flights and the fourth as standby and reserve aircraft. The four aeroplanes averaged 1,357 revenue hours per annum during the first ten months of use; this figure is regarded as satisfactory for a small fleet during its first year of operation.

Aer Lingus Teoranta (Air Fleet, Ltd.) are a subsidiary of Aer Rianta Teoranta (Air Routes, Ltd.) (the Irish Government company which operates the airports of Dublin and Shannon) and of British European Airways Corporation. The former holds 60 per cent of the share capital and the latter 40 per cent. The 1946 agreement between the Irish and British Governments provided that Aer Lingus should operate all scheduled services between the Republic and the United Kingdom, and that profits and losses should be shared equally between the parties. On the other hand, profits from routes to European destinations are divided according to the shareholding in the company, while losses are equally shared. During the last few months, discussions have been in progress between the two governments for a revision of the agreement, but, so far, no statement of the outcome has been made. It is surmised in Dublin that the shareholding will be altered, and that B.E.A. may operate into Dublin —and, perhaps, into Cork, when the proposed new airport is built there. At present, K.L.M. are the only foreign airline operating into Dublin on the joint Dublin-Amsterdam route, but, if the recent Anglo-German air agreement is any guide to things to come, it is possible that Lufthansa may open a route to Dublin.

A glance at the routes of Aer Lingus shows it to be an ultra-short-haul operator, for the average passenger pays £4 18s to travel 224 miles. These routes are of two kinds, the all-the-year-round service and the summer season route. During the winter months, the services are reduced to London, Paris, Amsterdam, Glasgow, Liverpool, Manchester, Birmingham, Cardiff/Bristol and to Shannon, but there are services to the Isle of Man, Edinburgh, Jersey, Biarritz/Lourdes and Lourdes/Barcelona during the summer season. Most of these routes are served by the evergreen DC-3, the Viscounts being used on the London, Paris and Amsterdam services. Six of the DC-3s are fitted with double loading-doors and folding roof-racks, enabling up to nine stretchers to be installed, together with seats for 18 passengers, and these are used on the Lourdes Pilgrimage flights. The other seven are 32-seaters, having eight rows of four-abreast non-reclining seats on rails, and all can be converted very rapidly to cargo-carrying. The four Viscounts have the 53-seat interior and are now fitted with Rolls-Royce Dart 506 engines. Aer Lingus were the first operator to have Viscounts fitted with the Murphy MR69 public-address system on delivery. All Aer Lingus aeroplanes are named after Irish saints, EI-AFV, the Viscount flagship, being *St. Patrick*. Last spring the fleet appeared with each aircraft's name beneath the flight-deck in Irish script, a fact which may have puzzled many people outside Ireland. In Ireland there are two official languages, Erse and English, and previously the names were in English.

In November, 1950, Aer Lingus were awarded the Cumberbatch Trophy by the Guild of Air Pilots and Air Navigators of the British Empire for "safety and regularity of operations." The only Aer Lingus accident involving loss of life among passengers occurred in January 1952, when a DC-3 crashed in the Welsh mountains; violent turbulence in the lee of Snowdon was regarded as the probable cause. A great deal of the credit for the airline's safety standards is, of course, due to the efforts of the engineering division of Aer Lingus at Dublin Airport, Collinstown, County Dublin. Here, about 5½ miles north of Dublin, are situated the workshops, machine-shops, ancillary equipment laboratories and test-bays, drawing-offices, stores and administration blocks. Besides the overhaul of all fleet units, the division is also A.R.B.-licensed for the manufacture of aircraft components and sub-assemblies under contract to the Bristol Aeroplane Co. and to Vickers-Armstrongs, Ltd. Technical courses for Viscount maintenance engineers of Central African Airways Corporation have been held at Dublin Airport, and Viscount operations manuals, prepared by the company in the early days for their own staff, have been supplied to a number of Viscount operators and prospective Viscount customers. On the aircrew-training side, Aer Lingus have undertaken the conversion and line-training to Viscounts of a number of Central African Airways pilots and of two pilots of the Department of Civil Aviation, Federation of Rhodesia and Nyasaland.

At Shannon, on the Atlantic seaboard of Ireland, the Aer Lingus traffic-handling unit has achieved a reputation for efficiency in handling the aircraft of all the transatlantic scheduled operators who use the airport. Another activity of the airline is the Aer Rianta Education Service which, since 1950, has distributed air information, organized lectures on aviation and conducted instructional airport tours for Irish schoolchildren.

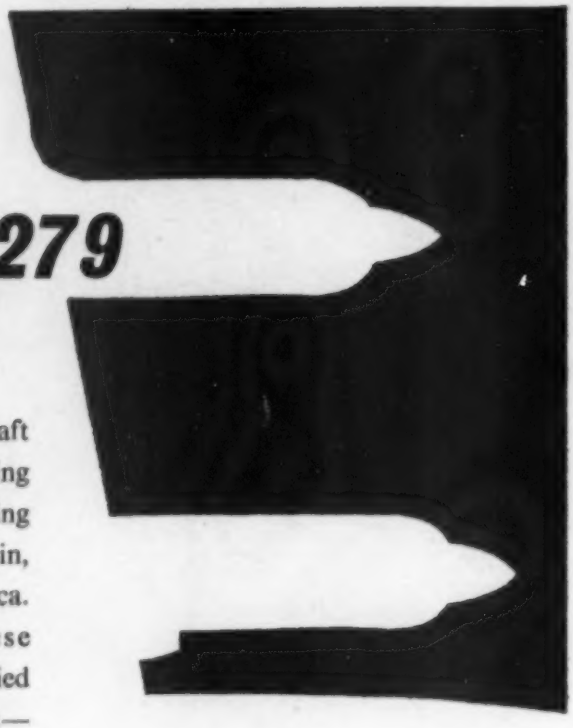
The accounts of Aer Lingus for 1954-55 showed a surplus of £84,600. Payment of charges for State services, interest on capital expenditure and depreciation left a net profit of £26,548, which was set against the accumulated deficit of £145,976. Future profits will be set aside in the same way until the deficit has been eliminated, enabling Aer Lingus to remain independent of State assistance (except in the provision of capital), as it has done for the past five years.

L. S.

The Vickers Valiant is powered by ROLLS-ROYCE
AVON ENGINES
FOR SPEED AND RELIABILITY

25,148,279 miles

were flown by BEA aircraft during the year ending September 30, in serving 67 airports in Great Britain, Europe and North Africa. In the course of these operations BEA carried 2,099,407 passengers—312,941 more than in the previous year.



fly BEA in Europe's finest airfleet

BRITISH EUROPEAN AIRWAYS

DESIGN OF HELICOPTER STATIONS

Liverpool City Engineer's Lecture to the Helicopter Association

AT the third meeting of the Helicopter Association's 1955-56 lecture season, held in the library of the Royal Aeronautical Society on Friday last, a paper entitled *The Design of Helicopter Operating Sites* was presented by Mr. H. T. Hough, M.I.C.E., M.I.Mun.E., City Engineer and Surveyor of the City of Liverpool. Dr. G. S. Hislop was in the chair.

Mr. Hough began by explaining that, although he had been concerned with airport design and management, he had never been engaged directly in the aviation industry and his remarks should, therefore, be treated as those of a layman. He felt, however, that the views of a municipal engineer on this question could serve a useful purpose. His own experience included passenger flights in four different types of helicopter in this country, on the Continent and in the United States of America. The most useful experience had been when, at the invitation of the Port of New York Authority, he had flown in a Bell 47D helicopter from Newark Airport to the landing platform on the roof of the Authority's sixteen-storey building in lower Manhattan. Flights with Sabena from Antwerp to Brussels Heliport and with B.E.A. on the Liverpool - Cardiff passenger service had also been instructive. He had, too, taken a keen interest in helicopter developments and made a study of the types of helicopter stations which would be required in towns.

Speaking as a municipal engineer, he offered a significant warning to those interested in helicopter development for commercial use. Large cities were not likely to leave sites in their valuable central areas vacant until 1965, and soon the nearest available open spaces to some of our city centres would be the airports at present used by fixed-wing aircraft! In this respect, his own view was similar to that expressed in the first report of the Interdepartmental Helicopter Committee in 1950, namely, that the manufacturers should be required to produce helicopters to suit the landing areas available and not rely on the provision of landing areas to suit the helicopters.

On the other hand, the designer of a helicopter station should obtain as much knowledge as possible of the types of helicopter which might make use of it before embarking on the project. It appeared that the type of helicopter which would be used between city centres would undoubtedly be a multi-engined machine with gas turbine engines and with passenger capacities from 20 to 40. Their loaded weights would be between 20,000 lb and 45,000 lb and maximum size up to 140ft in length and 105ft in overall width, according to configuration. Certain helicopters, such as the tandem-rotor Bristol 173 with 16-20 passenger seats and orthodox piston engines, might be suitable for preliminary services between towns.

The maximum size of landing ground which physical conditions in the cities of Great Britain would allow was one capable of handling 40-seater helicopters. Handling techniques in different types played an important part in the design requirements for the station and also in its location. Noise was another important problem to be considered and, in this connection, the lecturer quoted from a recent paper by Horonjeff and Lapin, presented to the Institute of Transport and Engineering, University of California: "So far no noise standards have been agreed upon but some measurements of noise suggest that a noise level not exceeding 75-80 decibels at 150 feet would be a desirable target to aim at for daytime operations. This appears to be a stringent requirement in so far as the manufacturers are concerned and compromises will eventually have to be made."

The lecturer went on to say that noise was a problem mainly for the helicopter constructor. It was hoped that the use of suitable silencers would reduce noise to a level not noticeably greater than that of a city's surface traffic but, if this were not the case, the noise might be the limiting factor in determining the size of helicopter permitted to land in central areas. Related to this problem was that associated with down-draught on the larger machines. The effects of this in streets adjacent to the landing area had to be considered.

The location of the site was most important because, to be of benefit, the helicopter had to operate from areas convenient to the passengers. In large towns, it was obvious that several helicopter stations would be required, not all of them being necessarily near the city-centre. In smaller towns, the need for a town-centre site was not so important as in London or other large cities, and the siting of helicopter stations on the outskirts of some country towns (perhaps less than a mile from the centre) should not be difficult. For towns such as these, which would never be likely to be able to afford to construct an airport, the helicopter might certainly be the means of providing air travel and a direct link with the trunk air routes of the world.

From the town planning point of view, the site must be chosen to fit in to the general plan for the town in question. One purpose of the Town and Country Planning Acts was to ensure that a site suitable for an important utilization was reserved for that and not covered by some other buildings. The location chosen should possess the following attributes:—

(a) Minimum obstructions in the approach and departure areas.
(b) Minimum disturbance likely to be caused by noise.
(c) Good access for surface transport.
(d) Minimum cost to acquire and develop.

The utilization of adjacent land was also a factor for consideration. The helicopter station itself should comprise the following facilities:—

(a) Take off and landing area.
(b) Passenger embarking arrangements.
(c) Helicopter waiting space.
(d) Terminal building with control room and accommodation for passengers and staff.
(e) Car park.

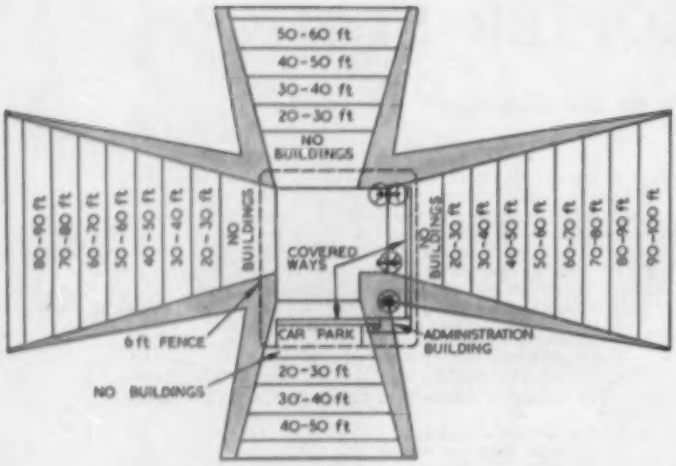
Since the location of the site was likely to be in an area where land was expensive, overhauls and servicing should normally be envisaged at a nearby airport, as should any prolonged parking of the machines. Refuelling, engine-starting and fire-fighting appliances would be necessary, however, and also ground equipment for night and bad weather navigation aids. To allow for varying weather conditions and emergency landings, and bearing in mind the dimensions of projected 40-passenger helicopters, the take-off and landing area should consist of two "strips" at right angles measuring 400ft by 300ft each. These dimensions were in keeping with recent suggestions by the M.T.C.A. but it would be advantageous if the exact size requirements could be fixed authoritatively at an early date so that both station designers and helicopter constructors would be working towards the same end.

A climb-area plane, free from obstructions at a slope of 1 in 10 and diverging 15 deg on either side at each end of the strips, had also been recommended by the M.T.C.A. Furthermore, obstructions within 100ft of the side edges of the strips should not be allowed to project above a plane inclined at 45 deg and passing through the sides of the strips. It would undoubtedly be difficult to achieve the climb plane of 1 in 10 at ground level in a city centre and, perhaps, a gradient of 1 in 6 would meet the safety requirements.

It had been assumed that one aircraft movement every five minutes would be made at such a station during peak periods and that the average turn-round time per machine would be 20 minutes. It was possible, therefore, that approximately 150 passengers might be in various parts of the terminal building at the same time. Accommodation provided for them should be the minimum which would enable them to use the station without fuss or delay. This should include a spacious foyer, ticket and left-luggage offices, provision for light refreshments, etc., and toilets and public telephones. Customs facilities would be needed only at a very small proportion of helicopter stations.

The total area of such a station would be approximately 8.3 acres but, with an unobstructed climb-plane of 1 in 10 gradient, a further area of nearly 40 acres would be subject to restrictions as far as building heights were concerned. If the climb-plane

Sabena's helicopter terminal near the centre of Brussels.
"Flight" photograph



Hypothetical helicopter landing ground illustrated by the lecturer, showing building-height restrictions to permit a climb-away gradient of 1 in 10. In the shaded areas, buildings higher than those in the four take-off zones would be permitted, though there would still be restrictions; in the unshaded areas between the zones there would be no restrictions. The landing area would be approximately 400ft square, and each of the gradient "steps" would measure 100ft along the approach or take-off path.

DESIGN OF HELICOPTER STATIONS . . .

gradient were reduced to 1 in 6 the restricted building area would be reduced to just under 20 acres. This made an appreciable difference to the cost of construction (Tables I and II) and it was doubtful whether many large cities in Great Britain could afford to reserve sufficient space in their central areas to accommodate such a ground level station if, indeed, any could. It would appear, therefore, that surface stations would be suitable only for smaller towns except where there was a park near the business area of a large city which could be utilized for the purpose.

One alternative for a large city, Mr. Hough continued, was the use of a roof-top station which, in fact, had certain obvious advantages; the height reduced difficulty in siting, in relation to existing high buildings, and drastically reduced the area of land affected by building height restrictions; the area of the site itself could be reduced, since terminal buildings and car-parking facilities could be incorporated under the landing strips; noise and down-draught were further removed from the streets, and, finally, parts of the building could be used for other purposes so that only a portion of the site value would be attributable to the helicopter station.

The only apparent disadvantage of the roof station was that the extra cost of providing and supporting a sufficiently strong roof slab might be so much more than the cost of the ground-level station as to outweigh its advantages. However, it was felt that the extra cost would probably be no more, and in some cases possibly less, than the cost of sterilizing, either wholly or partly, much valuable land in the climb planes of the ground-level station. The lecturer made no estimate of the actual construction cost, but the site value would be in the region of £72,000, assuming that only 50 per cent of the value was attributable to the helicopter station. One important point had to be borne in mind in this respect; the large area of the roof would reduce natural lighting and the building would, to some extent, be limited to such uses as warehousing and car parking.

The use of a roof over a railway station or sidings might not be so economical, since the structure to support the landing area would have little or no secondary use, but the possibility was worthy of consideration where the location and size of the railway station was suitable.

Design requirements for a roof station would be similar to those for the surface station, with the following main differences: passenger embarkation could be simplified by the use of short stairways to embarkation points from the floor below; lifting arrangements from the street would be required for engine starting, refuelling and fire-fighting appliances (these could be either internal "goods" lifts or external hoists and they would also be used for lowering engines or fuselages of unserviceable helicopters to road vehicles); special fuel pumping arrangements would be needed; and a device to prevent helicopters over-running the strips also would have to be provided. The last-mentioned item might take the form of short slopes, at the edges of the landing area, surmounted by kerbs.

The structural design of a roof suitable for helicopter landings presented a number of problems related to point loading and the isolation of the general structure from vibration or shock. The distributed load, of the order 10 lb/sq ft, did not offer any design difficulty and was well within the strength capabilities of modern steel-framed buildings. Point load was another matter and, in the case of a 50,000 lb helicopter for example, the design of the roof beams and slab assumed a problem of magnitude. A project for small helicopters, involving the use of a tank and floating raft for landing had been reported from the United States [illustrated in *Flight* of October 7th and it would be interesting to know whether it would be feasible and economic if applied to the case of heavy machines. Another interesting possibility was that, perhaps, modern methods of wing construction, as practised by aircraft constructors, might be applied to the roof superstructure to provide the necessary strength in a light metal design.

There were several examples of roof-top landing sites in the United States and an outline scheme for such a station had been prepared for Liverpool. It was on a site in the centre of the city reserved for a coach station and multi-storey car park. Its dimensions were 600ft in length with a maximum width of 290ft. One landing strip 400ft × 300ft could be provided, with waiting space for two large helicopters.

A second alternative to the ground-level station was the use of a floating platform for cities which had large stretches of water near their central districts. Design requirements would again be similar to those for a surface station but the terminal buildings, etc., would probably best be situated on land. Floating stations were well worth consideration by local authorities with suitable stretches of water.

The lecturer concluded by suggesting that it would be most helpful if the Interdepartmental Helicopter Committee could produce a second report in the near future with more specific guidance for local authorities as to when the helicopter might be expected to have been developed into a safe, reliable and economic vehicle for inter-city passenger services. The committee might also determine suitable passenger capacities and flying requirements for transport helicopters to be followed by aircraft constructors and to be used by local authorities for the purpose of reserving sites and designing stations from which these machines could be operated.

Table I: Cost of ground-level station away from the centre of a town where an average building height of 30ft may be expected.

	Climb Plane 1 in 10		Climb Plane 1 in 6	
	Sq yd	£	Sq yd	£
Site area ...	40,000 at 10s	20,000	40,000 at 10s	20,000
No-buildings area	18,000 at 10s	9,000	6,100 at 10s	3,050
Buildings 20ft-30ft	21 400 at 3s	2,140	12,000 at 3s	1,200
TOTALS		£31,140		£24,250

Table II: Cost of ground-level station in city centre where an average building height of 80ft would be allowed.

	Climb Plane 1 in 10		Climb Plane 1 in 6	
	Sq yd	£	Sq yd	£
Site area ...	40,000 at £6	240,000	40,000 at £6	240,000
No-buildings area	40,000 at £6	240,000	16,000 at £6	108,000
Buildings 30ft-80ft	155,000 at £2	310,000	78,000 at £2	156,000
TOTALS		£790,000		£504,000

R.Ae.S. ASSOCIATE EXAMINATIONS

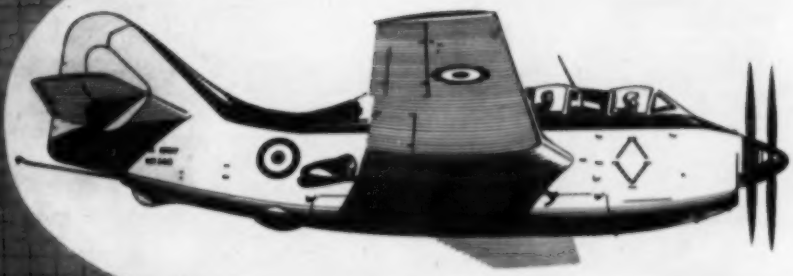
THE Royal Aeronautical Society has issued the pass list for its Associate Fellowship examinations held last June, under both the old and the revised syllabus. Names of the successful candidates are as follows:—

Part I.—F/Cdt. J. Armstrong, K. G. Balija (India), Sgt. A. Beedle, F/Cdt. T. J. Burns, R. Malet de Carteret (Canada), D. S. Carton, Tulsi Dass (India), R. F. M. Drake, F/Cdt. P. R. Evans, F/Cdt. M. Farmer, R. T. Harris, K. G. Hodson, G. A. Hopkoper (Holland), K. Kumar (India), J. R. Lyon, G. G. Mahajani (India), A. A. Munday, F/Cdt. S. T. Newington, D. T. F. Ozanne, E. Roadnight, K. Sanjeevan (India), M. Shamarao (India), G. M. Turner.

Part I (new syllabus).—V. Shirdher Hedge (India).

Part II.—M. G. Cherry, F/Cdt. P. R. Evans, T. E. Fitzsimmons, D. Gill, M. J. Harris, S. M. Humphry, Capt. Milos Jelinek (Israel), M. V. Karve (India), K. R. Liversage, M. H. Lock, P. L. Manley, H. F. C. Newby, F/Cdt. S. T. Newington, R. A. Nicol, G. T. O'Brien, T. O'Brien, T. Opatowski, D. T. F. Ozanne, K. G. Page, T. S. Nagesha Rao (India), B. N. Vaman Rao (India), M. Shamarao (India), Sucha Singh (India), K. M. Smith, K. S. Subrahmanyam, D. H. Tipper, B. S. Ward.

Part II (new syllabus).—L. A. Hall, N. W. Jones.



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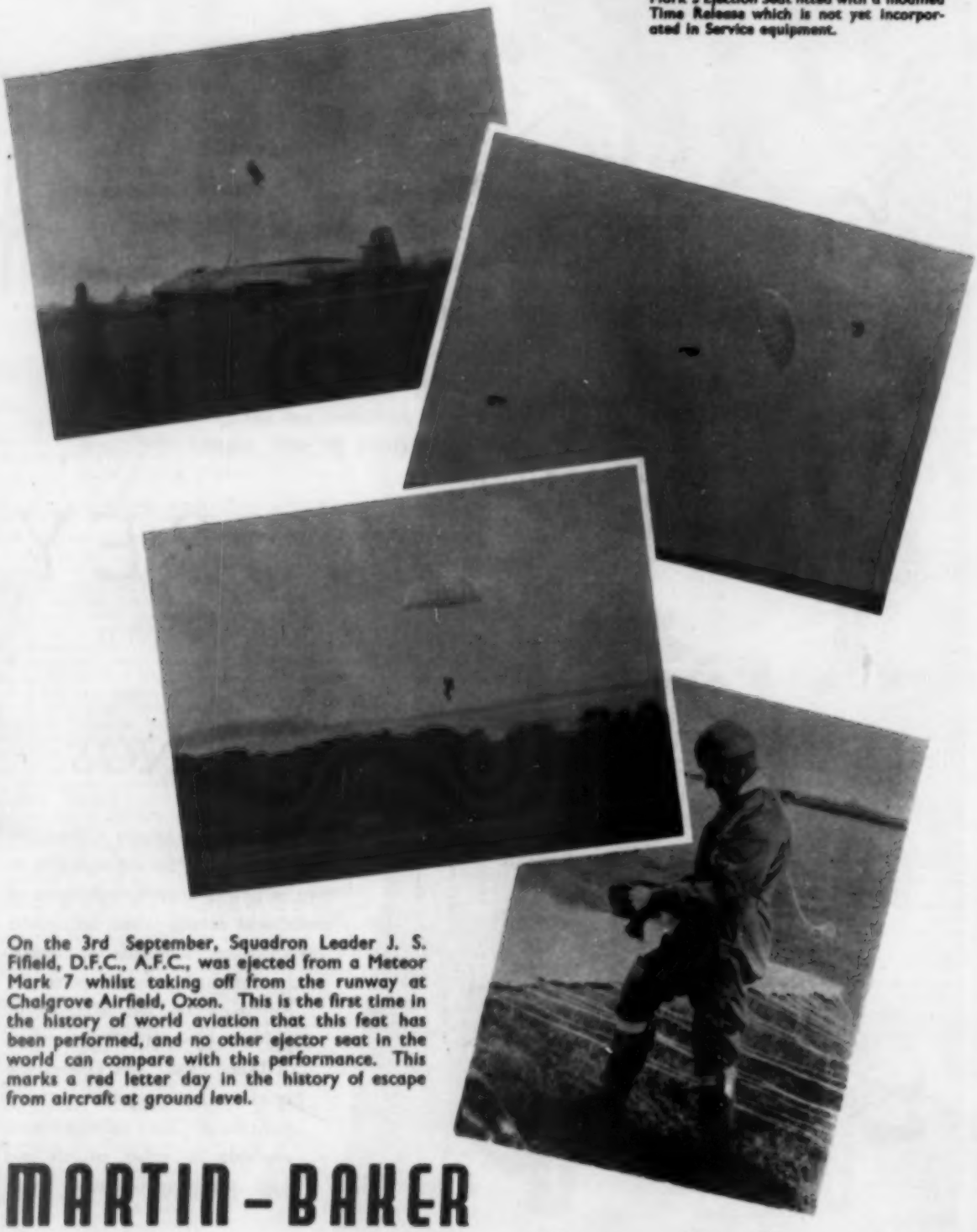
NOTE TO AIRCREW.

This test was carried out with a standard Mark 3 Ejection Seat fitted with a modified Time Release which is not yet incorporated in Service equipment.



On the 3rd September, Squadron Leader J. S. Fifield, D.F.C., A.F.C., was ejected from a Meteor Mark 7 whilst taking off from the runway at Chalgrove Airfield, Oxon. This is the first time in the history of world aviation that this feat has been performed, and no other ejector seat in the world can compare with this performance. This marks a red letter day in the history of escape from aircraft at ground level.

MARTIN-BAKER

Aircraft Company Limited

An anti-atom-flash planing bottom and lower surfaces distinguishes the second prototype Martin SeaMaster which, as recorded last week, was recently inspected by Earl Mountbatten. This example has full operational equipment. The light aircraft below (flown by our good friend Jacques Nostinger) is the Frati-designed F.8 Falco built by Mario Vietri.

AIRCRAFT INTELLIGENCE

U.S.A.

North American F-100C. Subject of our general arrangement drawing this week, the F-100C Super Sabre is now coming off the production lines of North American's "second source" plant at Columbus, Ohio. Two F-100Cs were fully tested for service and accepted by the U.S.A.F. exactly 56 weeks after the announcement that the line had been established. The F-100C is already in operation with the 322nd Fighter Day Group at Foster A.F.B., Texas, to which the first new Super Sabres were delivered from North American's Los Angeles plant on July 14th this year. Modifications incorporated in the "C" model include single-point flight-refuelling, additional fuel and bombs (the drawing shows a 7,000 lb load), and improved electronic methods of "accurately delivering bombs."

Douglas C-133. Next March is given as the first-flight date of this great military transport, designed to carry a payload of 25 tons on the power of four Pratt and Whitney T34 turboprops. The prototype is being built at Long Beach.

Douglas A3D Skywarrior. Speeds considerably in excess of Mach 1 have been achieved in dives by this carrier-borne attack bomber. One machine failed to pull out of a shallow supersonic dive at Edwards A.F.B. recently and the pilot and flight engineer were killed.

Douglas F5D. Now under construction at the Douglas El Segundo plant is this new Navy fighter, a development of the F4D Skyray, having a thinner wing and tail surfaces, a longer fuselage and higher fineness ratio. The first machine should leave the line early next year.

Martin SeaMistress. Projected by Glenn Martin, this flying-boat, no details of which have been disclosed, is intended as a successor to the P6M SeaMaster.

France

Bréguet Orders. It was recently announced by M. Sylvain Floirat, president and director general of the Société des Ateliers d'Aviation Louis Bréguet, that the company's capital had been increased to one billion francs and that the backlog ensured a turnover "largely sufficient" for several years. The main orders are for the following: Bréguet 1050 anti-submarine aircraft, of which a pre-production batch has been ordered by the French Navy and which is likely to be followed by a large production order; Bréguet 1001 single-jet and 1100 twin-jet light tactical support aircraft now being developed, respectively, to NATO and French Air Force specifications (three of each type are now on order, including a "1100" for the French Navy); Bréguet 940 Integral, a short take-off aircraft of which a prototype is being built; Bréguet 765 (military version of the 763 Deux-Ponts), 23 of which have just been ordered for service with the transport group of the French Air Force. The Bréguet company is also specializing in glider construction, and sixty examples are being built of the 901, winner of the 1954 world championship. The company also handles sub-contracts.

NORTH AMERICAN F-100C SUPER SABRE
(Pratt and Whitney- or Ford-built J57, with afterburner)

Span	...	...	...	...	38ft
Length	...	...	...	...	47ft

Britain's Aircraft—a Pronouncement

A Ministerial Review of Progress with Civil, Military and Research Aircraft

FOLLOWING a Ministry of Supply Press conference held in London last week it is possible to publish a broad account of British progress in the development and production of fixed-wing aircraft. The overall picture is not entirely unsatisfactory; in fact, there is good reason to believe that, in certain fields, we stand a good chance of equalling or surpassing the best that will be done in other countries.

It is not generally appreciated that, in terms of actual aircraft produced, the British industry's output is at present running at 2½ times the level of 1950. This is seen to be a particularly impressive achievement when the overall complexity of the industry, and in particular its long development periods, are considered. From now on, however, it is likely that there will be something of a recession in military output, for it requires less production to maintain a big force than to build one up. We can therefore expect the industry to settle down during the next year or two to a size appropriate to the prevailing conditions.

There remains of course, the oft-repeated criticism of "too many channels for too little water." It was officially suggested last week that, although we are second to none in having bright technical ideas, we spread our resources too thinly and so run into trouble in trying to bring the ideas to fruition. In fact, by trying to beat everyone at everything, we are failing to win any of the races upon which we are engaged. (Such a contention will not surprise our friends in the U.S.A., but it is new to have this view expressed by responsible spokesmen in Britain.)

Civil Aircraft

Bristol Britannia. Although a progress-report on this aircraft was published by us last week, the official view is repeated here, to complete the picture. Progress is good, and the fatigue-testing in the R.A.E. tank has gone "very well." The difficulty of finding severe icing was described as a "bizarre, but no doubt genuine" cause for delay, and there was no reason to expect further delays. By 1958 or 1959, the L.R. Britannia would be on the non-stop transatlantic route for B.O.A.C. (this is two years later than the original figure, and we believe that Bristol will, in fact, deliver L.R. machines in 1957) and six Britannia 250 L.R. aircraft were shortly to be ordered from Short Brothers and Harland, Ltd., for Transport Command. The latter order is referred to in the paragraph dealing with the Vickers 1000.

de Havilland Comet. Although deliveries are not scheduled until 1959, the Comet 4 time-scale was described as "tight," and the view was put that it was "vital that deliveries shall not slip further back. If the Ministry of Supply can help the manufacturer they will be glad to." B.O.A.C. have 19 Comet 4s on order, and these will be used on several routes, including the Atlantic (with one refuelling stop).

Vickers-Armstrongs Vanguard. B.E.A. were "showing an interest" in this aircraft, and might order it (a naïve statement, considering that the entire design has been planned for that operator). Vickers might develop the Vanguard as a private venture, but the M.o.S. were discussing with Rolls-Royce the possibility of a Government contribution to the development cost of the Tyne turboprop (which has no announced military application).

Vickers would soon be in the unusual position of having no military production—outside the guided-weapon field—and they "might be able to establish a continuing line of ever-stretching transports, Douglas-fashion, to keep Weybridge busy." The Viscount, of course, promised to continue to be a best-seller.

Other types. There was an enormous market for civil machines of all types, and Britain should be able to build up an encouraging export trade in transport and other aircraft over the next eight to ten years, and so make a significant contribution to the national economy.

Military Aircraft

Day fighters. As a means for "knocking down other aircraft" the Hawker Hunter was considered to be as good as any other aeroplane in the world; this was a carefully worded statement, and took account of all-round performance, fire power, and other factors, including squadron opinions. Availability of Hunters was good, and "until recently" (this was clearly a reference to the strike at the manufacturing plants) the type had been in quantity production.

The next stage was the English Electric P.1, which was "coming on well," and was to carry "very heavy armament." Both this type and the Fairey Delta 2 had achieved supersonic speed in sustained climbs—the P.1 had done so in 1954. After the P.1 there were many alternative possibilities.

Two of these possibilities were the Saunders Roe SR.53 and the Avro 720—both supersonic intercepters powered by turbojets and rocket motors in combination. Both projects were planned to M.o.S. requirements, and several alternative lines of development were explored before finally settling on two designs for prototype construction. Finally a choice was made between the two, and the SR.53 was selected for further development. This choice stemmed partly from the fact that the Saunders-Roe design was considered technically superior; in addition, Avro were very heavily committed to "extremely important work for the M.o.S., over and above that on the Vulcan," and they should not run the risk of being overloaded.

A prototype of the Avro 720 may be completed. A Hawker Siddeley Group spokesman stated that "In terms of other Avro projects the 720 is not a large aircraft, and a correspondingly small number of people have been involved in its development." Work on the SR.53 was going ahead fast, and a prototype would fly in the relatively near future.

In the future there were many other interesting projects. One experimental machine which could be named was the Short P.D.11, a vertical-take-off prototype which was being built to M.o.S. order.

All-weather fighters. The Javelin was regarded as the most important aircraft for which the Ministry of Supply were held responsible. Recent progress had been "most satisfactory"; the point had practically been reached at which machines could be issued to the R.A.F., and the manufacturer had "got to the bottom of the development problems and had a solution for all of them." The type should be in service during the current financial year, and further developments were in prospect.

In March of this year it was stated that a development batch of 18 aircraft (following the new policy of ordering reasonably large batches for development trials) would be ordered from the Gloster company, of an entirely new design representing a significant advance over the Javelin. Development of A.I. radar was matching the progress of all-weather aircraft, and we would "not be entirely dependent on American sets" in the Javelin.

Bombers. Vickers-Armstrongs Valiants would steadily build up "to a certain level," and would then "fade." Of the Avro Vulcan it could be said that development problems were believed cured, and that the type compared favourably with any other machine in the world designed to similar requirements. The loss of the first prototype had put Handley Page behind with the Victor, but the type was making "encouraging progress." The Vulcan should be ready for service next year, and the Victor "a little later."

The wisdom of manufacturing both Vulcan and Victor in quantity had been questioned. It had been decided that it was better to do this than to transfer production of one aircraft to the factory of the other, which would result in widespread disruption. Both aircraft, incidentally, had great built-in development potential.

Considerable work was also going on in the development of supersonic aircraft, and some of this would also ease the task of formulating the design of a supersonic transport.

Transports. The Ministry of Supply issued the following statement at the conference:—

"The plans for re-equipping Transport Command with the Vickers-Armstrongs' long-range V.1000 transport aircraft have been under review in the light of the probable delivery dates of the aircraft and the general transport aircraft situation. As a result it has been decided to cancel the orders for the development and production of this aircraft. The contracts covered the production of one prototype and six aircraft for the use of Transport Command, whose needs will now be met by the purchase of the Bristol Britannia 250 L.R.

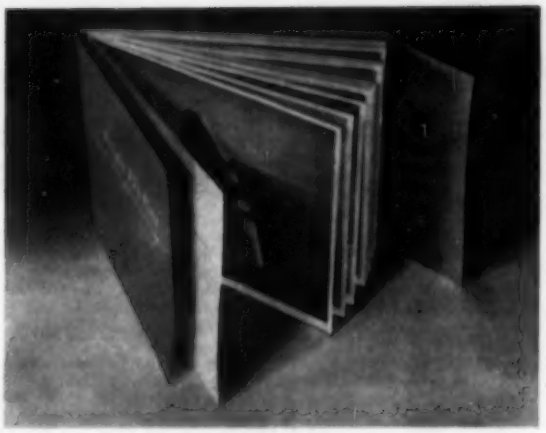
"It has taken longer than was hoped to overcome some of the problems of meeting the specification that was laid down for the V.1000, and the urgency of the need to re-equip Transport Command therefore led to the decision to take the long-range Britannia, which has been developed well and which can be made available earlier."

For this state of affairs no blame can really be laid at the door of the M.o.S. or manufacturer. Vickers were asked to take on a formidable task, and the specification was exceptionally stringent and exacting. As the design—and construction of the prototype—progressed, the weight rose, and finally increased to such a figure that, in spite of the rise in thrust of the Rolls-Royce Conway by-pass turbojet (the V.1000 engine) the aircraft would not have been successful (we quote the Ministerial view).

Regarding the proposed V.C.7, civil derivative of the V.1000, not only would the increased weight have impaired its operational flexibility, but its sales prospects would have been poor.

(*Concluded on page 779*)

"NIPPY WELTERWEIGHT: English Electric Canberra B.6."



The portfolio itself.

"FLIGHT FLY-PAST"—a perfect gift

MODERN AIRCRAFT PORTRAYED IN A UNIQUE COLLECTION

NOT without professional pride we announce publication this week of something quite out of the ordinary—a collection of twenty-four plates depicting current types of British aircraft. Sumptuously presented in portfolio form under the title *Flight Fly-Past*, it consolidates some of the choicest and most recent work of *Flight* photographers John Yoxall and L. W. McLaren. The plates are so disposed as to contrast one with another, and range from "straight" views of present-day machines (that of the Canberra, above, is an example) to ethereal vistas, outstanding among which is "Faery Lands Forlorn," wherein Sea Hawks swim like strange fish above a magical prospect of cloud, land and sea. Exotic, too, is the Boulton Paul P.111A, gulping through its intake close against the camera lens. A CF-100 flashes beneath the photographic machine in startling attitude and proximity, with every detail sharply recorded; and, wheeling in English air above a patchwork of fields is the beauteous Comet 3. Far removed, this, from the formation of Vampires trailing kerosene fumes across the glaring panorama of Singapore. There are Hunters, too—silhouetted above a cloudscape touched by a lowering sun; the Britannia, proceeding majestically on her lawful occasions; and a Shackleton, sweeping the tinfoil vastness of the Atlantic. "Fire in the Night" describes a scene wherein a Vampire's Goblin stabs the blackness with its fiery exhalation, and under the title "Hard Aport" a formation of Wyvern strike aircraft is a study in symmetry and perspective.

The complete list of aircraft depicted is: Avro Shackleton, Avro Vulcan, Avro Aircraft CF-100, Boulton Paul P.111A, Bristol Britannia, de Havilland Comet, de Havilland Vampire (two views), English Electric Canberra, Fairey F.D.2, Folland Gnat, Folland Midge, Gloster Javelin, Gloster Meteor, Hawker Hunter (two views), Hawker Sea Hawk, Hunting Percival Jet Provost, Hunting Percival Provost, Napier Eland-Varsity, Short Seamew, Short Sherpa, Westland Whirlwind and Westland Wyvern.

Each plate measures 12in x 10in and the cover is ripple-finished in grey, with silk-screen printing. White antique paper is used for the title page and index and the plates themselves are printed on specially made Carrongrove art paper.

Copies of *Flight Fly-Past* are obtainable from Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, price 7s 6d (8s 4d including postage).

(Above) John Yoxall in a 200 m.p.h. Hart.

(Below) L. W. McLaren in a 600 m.p.h. T-33.

"CELESTIAL STAIRWAY: Hunters in echelon starboard."

MAN-POWERED FLIGHT

A Stimulating Review by Mr. B. S. Shenstone at the L.S.A.R.A. Meeting

THE problem of flight with minimum power was the subject of a thought-provoking lecture given in London on Saturday last, November 12th, at the second annual conference of the Low Speed Aerodynamics Research Association. The speaker was B.E.A.'s chief engineer, Mr. B. S. Shenstone, and the title of his paper was *The Problem of the Very Lightweight, Highly Efficient Aeroplane.*

The people who wanted light and highly efficient aircraft, the lecturer began, were those who thought that a light aeroplane needing more than 50 h.p. was no longer light, those who wanted auxiliary power in their sailplanes, those who wanted a very light efficient glider that could be launched by the pilot and those who wanted to fly by manpower. The general problem was one of weight and drag. The payload, a man of standard weight of 165 lb, was constant, but everything else was fluid. Lilienthal had concentrated on a lightweight structure made of cloth and osiers. This arrangement had weighed approximately 65 lb, giving an all-up weight of 230 lb, and his gliding angle was approximately 5.5 : 1. This indicated that the power needed to fly level would have been about 1 h.p. at 16 m.p.h.

Almost 20 years ago there was a contest in Germany for aircraft operated by manpower. Four of these designs, although unsuccessful, were worth mention because of the low weights and good aerodynamics which had been achieved. These aircraft were the Bossi-Bonomi (Italy), the Haessler-Villinger (Germany), the Seehase (Germany) and an unnamed Russian design. In spite of the greater weights of these machines compared with Lilienthal's aircraft, the powers which they required were considerably less.

Very little had been accomplished since the time of the German contest, the lecturer continued. What had been done was indirect work by Raspet on the reduction in drag of sailplanes, which had resulted in much improved performance. Raspet's technique was extremely simple and was concerned with making the surfaces as smooth as possible, getting rid of leaks and eliminating interference between surfaces. He had been able to show that a minimum drag coefficient of 0.01 and high span efficiency factors were attainable and these could be applied to the type of aircraft now under consideration.

At 30 m.p.h. the Haessler-Villinger (77 lb empty weight) required only 0.82 h.p. If Raspet's improved drag coefficient were applied to an aircraft of this weight, the minimum power required would be reduced from 0.82 to 0.68 h.p. If the machine were not only cleaned up but also flown close to the ground (say 10ft) the power needed was reduced to 0.58 h.p. at 30 m.p.h. because of the reduction of induced drag caused by ground effect.

So far only the most straightforward and simple means for reducing drag had been considered, yet the estimated power required had dropped to 70 per cent of the originally achieved condition. If the pilot exerted himself at the rate of 1/10 h.p., which was possible indefinitely without fatigue, and if this power were applied to boundary-layer suction, the whole wing should achieve laminar boundary-layer conditions. This should reduce the power needed for flight by about 0.2 h.p. and with ground effect the necessary power could be reduced to about 0.38 h.p. These estimates had been based on the aerodynamics of the Tiny Mite sailplane used by Raspet, the minimum drag coefficient of which occurred at a lift coefficient much lower than those under consideration. It was probable that more highly cambered aerofoil sections designed for high-angle-of-attack flying would give better results.

Turning from the possible aerodynamic improvements to consider the aircraft structure, Mr. Shenstone emphasized that the development of sailplanes and light powered aircraft in the past had not led to particularly low structure-weights. The very scale of the low-powered aircraft under consideration revealed new structural problems which in some respects were akin to those met in large flying models. Very light structures were practicable for the speeds were low, the manœuvre loads were low and the load factors might be as low as four.

An interesting wing design was that of Seehase some 17 years ago. He had been carrying out research on man-carrying kites for many years, and had applied this knowledge to man-powered aircraft. He based his wing (43ft span) on the use of only four ribs per side, which were attached to two magnesium tubes acting as spars. The only other structures were a pair of nose ribs between each of the main ribs, and the whole wing was covered with stretched doped silk. The whole machine, complete with control surfaces and machinery for driving it by manpower, weighed only 79 lb, making a gross weight of 244 lb.

The main point was that the structural problem was probably far more difficult than the aerodynamic one, because it needed more patience. For a given speed the power required was directly proportional to weight. Most of the weight, being that of the pilot, however, was outside our control. The structures being considered were of the order of 75 lb, making a gross weight of the order of 240 lb, of which only one-third was under control. No matter what was done it was unlikely that this variable weight could be as much as halved, making a gross weight of 203 lb and lowering the power needed by 15 per cent or about 0.06 h.p. To be realistic there was not a great deal to be accomplished by decreasing the weight much below that already achieved, but there might be much to be gained by improving the aerodynamics for that same weight.

Although the power required was directly proportional to the weight at a given speed, it was also inversely proportional to L/D. If we could improve L/D without a proportional weight increase we were gaining. If the polar of the Haessler-Villinger cleaned up to Tiny Mite standards were studied it would seem that, at the low speeds being considered (C_L about 1.0) the total drag coefficient was about 0.03. Of that figure the induced-drag coefficient was 0.0187, or 62.3 per cent of the total. To reduce the induced drag the span must be increased, which meant adding weight.

Data on a large number of sailplanes indicated that the empty weight varied linearly with span over a range from 30ft to 60ft, the effect of aspect ratio being only secondary. Calculations showed that, if the span of the Haessler-Villinger were increased from 44.3 to 60ft, the gross weight would rise by 53 lb to 297.2 lb. If wing area were kept constant, approximately the same power was required; if, however, wing loading were kept constant, there was a slight reduction in power of about 1/20 h.p. But, if laminar flow could be achieved and ground effect used, the power required might come as low as 0.35 h.p. plus the power for laminarization.

This showed how a proper use of weight could result in a lower power being required. Over-generalizing, we could say that, by making an aeroplane 30 per cent heavier, we had cut down the power required by almost two-thirds.

This meant that even a man could fly such a machine. If he were launched at about 30 m.p.h., and if the drive and propeller efficiency were 75 per cent, he would need to exert 0.6 h.p. From data collected by Oscar Ursinus and published in 1936-37, this meant that, using feet alone, a man could fly for 50 sec or half a mile or, using both hands and feet, he could fly indefinitely.

If a two-seater man-powered aircraft were developed it could have a better power for its weight. From Wilkinson's work it was clear that, for a given span and aspect ratio, the two-seat glider needed an empty weight not more than 20 lb greater than the single-seater. Thus, if the aircraft described above were converted into a two-seater, the weight would increase by 20 plus 165 lb, making the gross weight 485 lb. Taking the same lower wing loading as used for the Haessler-Villinger of 2.26 lb/sq ft and 60ft span, it was found that an all-out laminar plus ground-effect assumption required 0.5 h.p. One man, the galley-slave, exerting both legs and arms together, with the pilot working only his legs, could produce a power of about 1 h.p. for an indefinite period

The Haessler-Villinger man-powered aircraft, in flight and on the ground. Span was 44.3ft.

The Italian Bossi-Bonomi, designed for the German contest for man-powered aircraft. Neither it nor the Haessler - Villinger achieved sustained flight by manpower alone.

if in training. If suction was assumed to require 0.1 h.p. the propulsive efficiency could be as low as 60 per cent.

What might such a two-seater look like? The illustration (right) showed what might be done if Dr. Raspet were in league with Mr. Haessler and Mr. Villinger. The propeller was not only to drive the aircraft, but through its hollow blades it was to pump out air from the wings to provide the laminar boundary-layer. Launching would be by towing or catapult.

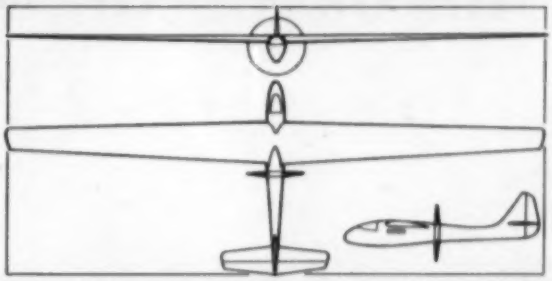
The third problem was that of the means of propulsion, which had had far too little attention paid to it in the past. The idea of attaching small motor-cycle engines with propellers had been carried out but with very little success because of the excessive drag of the unit. In most cases where these small engines had been applied, the aircraft itself had not been very efficient aerodynamically or structurally. While there seemed to be no reason why even auxiliary pedal-cycle engines should not be used to drive an aircraft, the obvious thing was to use the payload, i.e., "to use the power of the man, rather than let him sit there eating his head off or biting his nails." But if we did not want to use him, we could add an engine, which could be as small as 3 h.p. to fly one man at 50 m.p.h.

There were three possibilities: jet propulsion, propeller propulsion and flapping-wing propulsion. The speed of a low-powered aircraft was so slow that a jet would be highly inefficient and so the propeller, in one form or another, must be considered. In the aircraft under consideration, the aerodynamics were sensitive to disturbance and therefore it would be most unwise to use tractor airscrews, and hence the use of a pusher must be assumed.

Although most inefficient, we must begin with a pedal shaft lying in the spanwise direction. The propeller inevitably had a shaft which was at right-angles to that, and at a different level and some distance from the initial drive-shaft. One could use chains, belts, gear and connecting rods, and all of these had disadvantages. Chains and gears were heavy; belts produced high bearing loads and therefore heavy mechanisms; and connecting rods having shafts at right angles were mechanically impossible, although in practice they could be used.

The flapping wing could be considered as a propeller that did not go all the way round and there was no reason to suppose that it was any more efficient than a properly designed propeller, except for its effective saving of the profile drag of the propellers. It had one virtue, however, which was shared by no other means of propulsion for, if properly designed, it need have no parasitic drag when not in use, and was therefore the obvious means of propelling an aircraft which was intended to soar part of the time, i.e., when used as an auxiliary source of power.

For the man who wanted an efficient sailplane which he could handle all by himself, there existed the modern hang-type of glider such as the recent Horton X tailless design. For such an aircraft there might be a case for an auxiliary drive to extend the glide. Here was one application for the flapping wing if so designed that when not in use it had no extra drag. All or part of the wing might flap, and it was a design problem to discover in a given case whether it was easier to flap a small part of the wing quickly or more of it slowly. The use of auxiliary manpower in a normal sailplane was not worth much because they required so much power. A Minimoa, for instance, needed almost 3 h.p. to fly level.



Hypothetical two-seat man-powered aircraft, having 60ft span, 214 sq ft wing area, 485 lb gross weight, and 35 m.p.h. cruising speed.

"In 1955," the lecturer concluded, "the development position regarding manpowered flight is like that of powered flight in 1900. A few people then knew that flight was possible but there were gaps in the knowledge such as on wing section data, on light powerplants, on control and stability. Today we can see that if we stretch our knowledge and assurance very little, manpowered flight is possible. We need not be discouraged because this is apparently only possible at very low altitudes, at low speeds and at the expense of some complication and great physical effort. If we did not have to stretch ourselves to do this, it would long since have been done."

Points raised during the discussion following Mr. Shenstone's paper included the need to develop more efficient methods of obtaining thrust from muscle power; the possibility of boundary-layer suction by hollow-channel wing construction (i.e. without expending power); and the desirability of flexible wings. Such boundary-layer suction methods, the lecturer commented, indicated the type of improvement which could make the task of achieving manpowered flight even easier than his paper had stated. Bird-type flight using flexible wings would be an original contribution to knowledge whereas, in his own lecture, he had used only existing facts.

Other papers presented during the L.S.A.R.A. Conference were *The Use of Dynamically Similar Models for Research*, by T. Kerr; *The Aerodynamics of Zanonia Macrocarpa*, by Prof. A. Raspet (read by Dr. Whitehead of Oxford University); *Model Glide Testing*, by M. Hacklinger; and *Three Lecturettes: Two-speed Rubber Drive, Conditions for a Neutral-aileron Turn* and *The Payload Competition Problem*, by R. H. W. Annenberg. The chairman of the meeting was Mr. J. L. Nayler, M.A.

BRITAIN'S AIRCRAFT—A PRONOUNCEMENT (continued from p. 776)

One could not expect operators to buy so large and expensive a machine unless it was used by B.O.A.C., and the Corporation were already committed to the purchase of £85m worth of new equipment, which, Sir Miles Thomas has said, will fill their requirements into the 1960s.

This momentous decision drew forth (not unnaturally) a statement from Mr. George Edwards, managing director of Vickers-Armstrongs (Aircraft). He said "The decision . . . means we have abandoned to the Americans, without a struggle, this highly important market [for large jet transports]. How important this market is can be seen from the fact that the orders so far placed by a few American operators for big jets total over £200m. The future size of the market could be of the order of £1,000m. I think the decision to cancel Britain's only contender in this market is a national decision we shall regret for many years to come."

On the other hand the importance of the Rolls-Royce Conway is in no way affected by this decision; on the contrary, every means is to be sought to find applications for it, and it is contemplated that Conways should be installed in one type of V-bomber. Meanwhile, the prototype V.1000 will probably be completed next year, and it may find employment as a test vehicle.

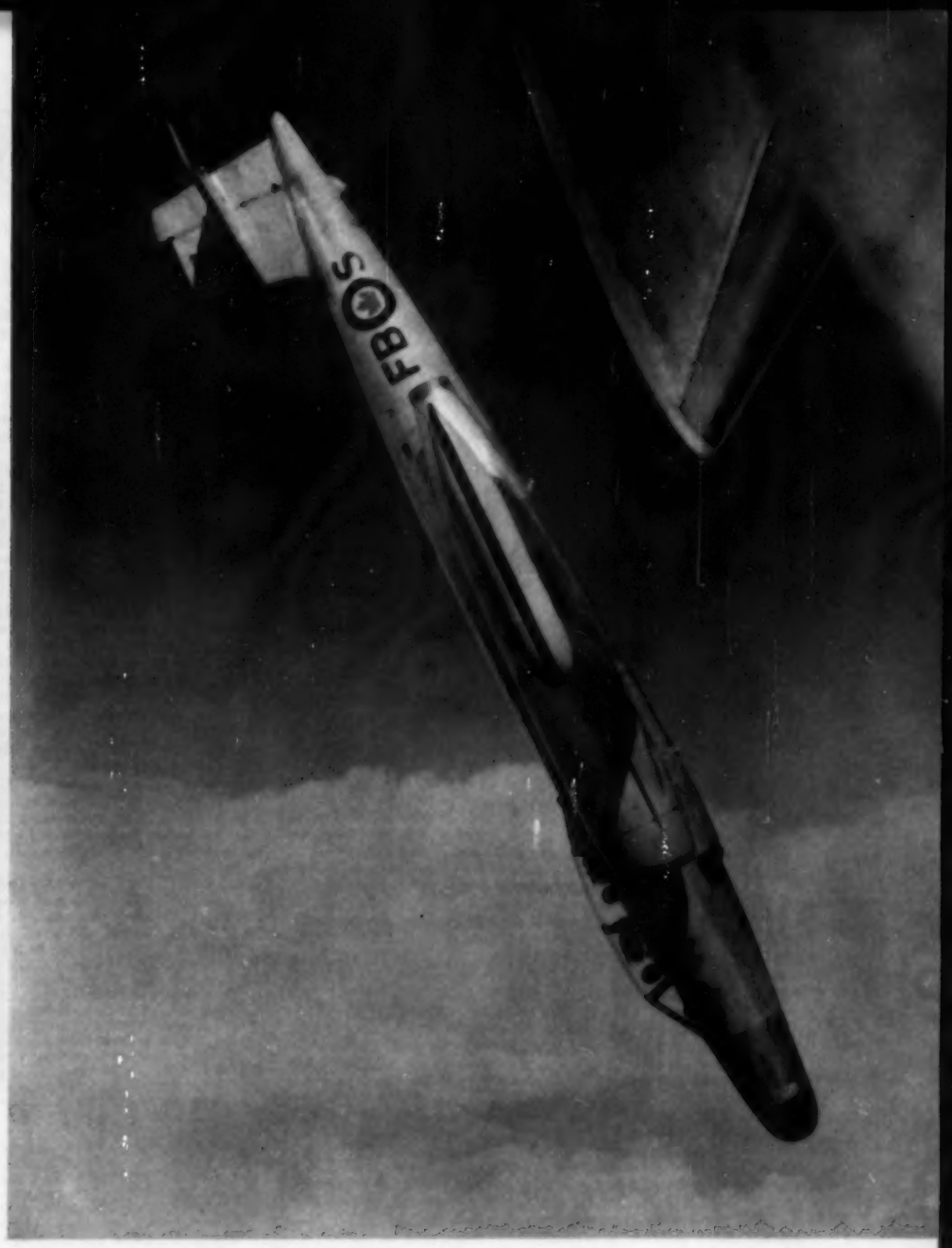
The new order for Britannias comprises six Britannia 250 L.R aircraft to be built at Belfast by Short and Harland. This order is additional to the three similar aircraft ordered by the M.o.S. from Shorts for the use of independent trooping operators.

A considerable amount of thought had also been given to the question of replacing the Vickers-Armstrongs Valetta as the standard short-range Service transport. The problem was particularly difficult, and no decision had yet been taken.

It was emphasized that, whatever cuts in expenditure might be made—and there were certain to be several—research would be left alone as far as possible. In the past, this country had been badly short of high-speed tunnels (although the position here was easing) and other equipment. Apart from the Fairey Delta 2, there were many types of advanced research aircraft in prospect; and, although we could not buy as many as were used in the U.S.A., it was considered that the types involved were just as ambitious as American research machines being built to a similar time-scale. This involved aircraft designed both for very high Mach-numbers and extreme altitudes.

Regarding guided-weapon developments, little more could at present be said. But it was thought that the American lead in this important sphere had not grown during the past year, and in some respects it had even been narrowed. Nevertheless, it was difficult to stretch a limited budget to cover development and production of two or more generations of weapons at once.

THE GRACE OF FORM AND MOTION



THE aeroplane is not only the fastest, but the most manœuvrable vehicle contrived by man; and its beauty is that of movement as well as form, as these pictures affirm. On the far left, leaping like a salmon, with the mountains and orange groves of California as a scenic backcloth, is a North American F-100A Super Sabre. Its ascent is a zoom rather than a sustained climb, for the variable nozzle of the reheat tailpipe is at normal setting. At the centre a Republic F-84F Thunderstreak, its undercarriage still lowered, rockets away under the urge of its J65 Sapphire turbojet and four JATO bottles, totalling 11,220 lb in thrust. Immediately above, like a falling arrow, an Avro CF-100 Mk 4 is caught by the camera as it pulls round from a loop, gathering speed for the final plunge and pull-out. The pilot, apparently, is already beginning to ease back on the control column, for the elevator has the merest upward deflection. On the left, a Canadair-built T-33, known to the Royal Canadian Air Force as the Silver Star, edges round the last stage of a formation roll —well barrelled, as is prudent in such a manœuvre.

THE EPOCH OF AIR POWER

Marshal of the Royal Air Force Sir John Slessor's Lecture at Hull

THE second Sir George Cayley Memorial Lecture was given before the Brough Branch of the Royal Aeronautical Society at Hull on November 10th by Marshal of the Royal Air Force Sir John Slessor, G.C.B., D.S.O., M.C. The following is a brief summary of the lecture, and of the discussion which followed.

The speaker began by comparing the remark made 40 years ago by a United States Army general—that "pre-occupation with an air force could only lead to disaster and defeat"—with Lord Montgomery's statement made a month ago that "air power is today the dominant strategic factor." Although these remarks had been made in the lifetime of men comparatively young today, it was an odd thought that the whole concept of air power was already in sight of changing, to one of unmanned air warfare. The speaker recalled the 1914-18 war, when air power was nothing more than a means of finding out what was going on on the other side of the hill; although it was not a decisive influence on the course of the war, even then there were glimmerings of its future significance.

In the 1939-45 war air power forced the Allied will on the enemy and proved that his normal life could be so interrupted that hostilities became unbearable. Speir had told the Fuehrer in 1943 that if the air war continued Germany would not be able to hold out much longer. Yet of the total tonnage of Allied bombs dropped on the Reich 85 per cent fell after January 1st, 1944, and 72 per cent after July 1st, 1944. Today one hydrogen bomb could wreak the same havoc. The 1939-45 war conceived the new idea that one's end in war could be achieved without defeating the enemy's armed forces. That was the first air war in history, yet at the beginning of it no one knew what air power was going to do. In 1938 the thought of Britain's succumbing to a "knock-out blow" was strongly felt, on the reckoning that the Germans were capable of delivering 400 tons of high explosive per day by 800 front-line bombers. It was easy to scoff now, but in the background of 1938, when we were practically defenceless, no one in Whitehall could have advocated war. It was calculated that 55 squadrons would be needed: in 1938 there were only 23, only five of them front-line units, and those equipped with Hurricanes with limited high-altitude performance. Anti-aircraft guns numbered 334, against the 960 it was estimated would be needed. Similarly searchlights and other ground equipment were 50 per cent below the estimated needed strength.

Bomber Command during the war had required seven per cent of the British war effort. But the speaker believed that had more attention been given to air power, particularly in the development of new scientific weapons, the war might have been shortened by a year.

Turning to the future, Sir John said that the only point in waging a war was to create conditions after it more favourable than if there had not been a war. Such a concept, viewed in the light of the H-bomb and bacteriological warfare, was today meaningless —war now meant mutual annihilation. Had war abolished itself? Even if it had, the speaker felt it was a waste of time talking with the Russians, except from a position of strength. What exactly was a position of strength? It was being ourselves in a position where we could formulate policy without worrying about attack. Spaak had spoken significantly when he said that the United States and the U.S.S.R. would soon have enough bombs to strike a mortal blow, and that it did not matter which country had the larger stockpile. Such strength did more than deter a would-be aggressor from undertaking total war—it could also deter him from pursuing a policy which might lead to total war. Today we were now negotiating from equality, not from superior strength, and readiness to accept H-war was implied by this position of equality.

The lecturer reaffirmed his belief in the importance of civil defence—the ability to cope with chaos when it came, and as a deterrent in itself. The fact that the Russians apparently had no civil defence was to his mind evidence that they were not ready for all-out war.

The most appalling dilemma today faced democratic statesmen. Could anyone bring himself to give an order which would certainly lead to total mutual annihilation? In the event the order would come from the enemy, and the lecturer believed that the Russians would never risk war unless they were sure we would surrender without fighting. We must thus, he believed, make our determination to fight quite clear.

Of "graduated deterrence," Sir John said this would invite trouble. He cited his own experience in the last war, when, as C-in-C. Mediterranean, he forbade the bombing of Florence "as a shrine of the civilization for which we were fighting," until only by doing so could the German tanks and guns in the railway yards be prevented from reaching the front. This was an illustration of how any agreement between combatants fails in practice, and that it was being unrealistic to suppose that one side would only use the H-bomb if the other did. It was, however, quite likely that there could be agreement in small wars on the limitation of weapons. It had been proved in Korea that it paid to give the enemy certain immunity, and that graduated deterrence—or "rationed demolition," as it had been called, was feasible in such limited wars.

Were we to assume that we needed only air power? He believed that this was not so. There seemed to be no hope of reducing the defence estimates in our lifetime—it would be a fight to keep them down. We had to have something between the H-bomb and the frontier policeman: divisions to fight infiltration and to deter the initiation of limited war by an enemy whose policy was to "approach round corners." Vice-President Nixon had spoken of the risk of being "nibbled to death." We could not prevent this simply by—to use Mr. Dulles' phrase —"massive retaliation." We had got to have a highly mobile reserve of land forces ready to move from A to B with their equipment as quickly as possible, which in his belief was another way of saying "Beverley."

Turning, in conclusion, to the enormous cost of maintaining deterrent power, Sir John suggested that we looked at those elements in our forces which were only necessary for a *brief* total world war, and to cut others who would only be of use in a long war.

In thanking Sir John, G/C. G. T. Weir, Officer Commanding R.A.F. Leconfield, said that most of us were apt to become too expert at one particular facet of aviation. We therefore owed our gratitude to Sir John Slessor, and to a few others, who reminded us of the broader aims toward which we were working.

The Discussion

In the discussion that followed, MR. J. HALL (experimental manager, Blackburn Aircraft) asked whether, had McArthur bombed beyond the Yalu, the war would still have been contained in Korea. Sir John replied that he doubted if it would have spread, but that in any case it would not have been an effective measure. The bombing of railways and roads in Korea could have been made to be just as effective as bombing their sources in China.

MR. P. B. LAIGHT (chief designer of Blackburn Aircraft) asked whether the speaker could give us a glimpse of where the R.A.F. will be, if we carried things to their logical conclusions, in 20 years' time. Sir John replied that it was not always a sound thing to carry things to their logical conclusions—lunatic asylums were full of people who had done just that. He felt that manned aircraft would be in the front line for a very long time ahead, especially to deter small wars. Certainly, of course, in time the front line strength of air power would be entirely unmanned.

MR. F. N. BARNES (flight development engineer, Blackburn Aircraft) asked whether the H-bomb had not been over-rated. Sir John replied that even if it had he would prefer to be on the very point where it dropped, rather than be exposed to the terrible effects of fall-out.

MR. R. C. TETLEY (electrical D.O., Blackburn Aircraft) asked how we could gain the initiative and keep the opposing side on the defensive. The speaker replied that we were by nature defending our own way of life and not wanting to attack any one else's.

DEATH OF NEW ZEALAND PIONEER

THE death has occurred at his home in New Zealand of W/C. James Duff Hewett, one of the Dominion's pioneer airmen and a pilot in two world wars. For his outstanding service in the air in World War I, W/C. Hewett was decorated by France with the Croix de Guerre, and at the outbreak of World War II he became a staff pilot with the R.N.Z.A.F. When 42 (Transport) Squadron was formed in the early years of the war he was its first commanding officer.

W/C. Hewett, who was awarded the Air Force Cross for his work in World War II, practised what he preached—safety in the air—and built up an unblemished record of many thousands of hours' flying.

Between the wars, he was one of the best-known commercial pilots in New Zealand. With A. Cdre. C. E. Kay he finished fourth in the England-Melbourne Air Race of 1934. After the race they flew across the Tasman Sea, becoming the first New Zealanders to fly from England to New Zealand and the first New Zealanders to fly the Tasman.

During World War II, W/C. Hewett flew nearly all distinguished British visitors in his well-known Dominie.

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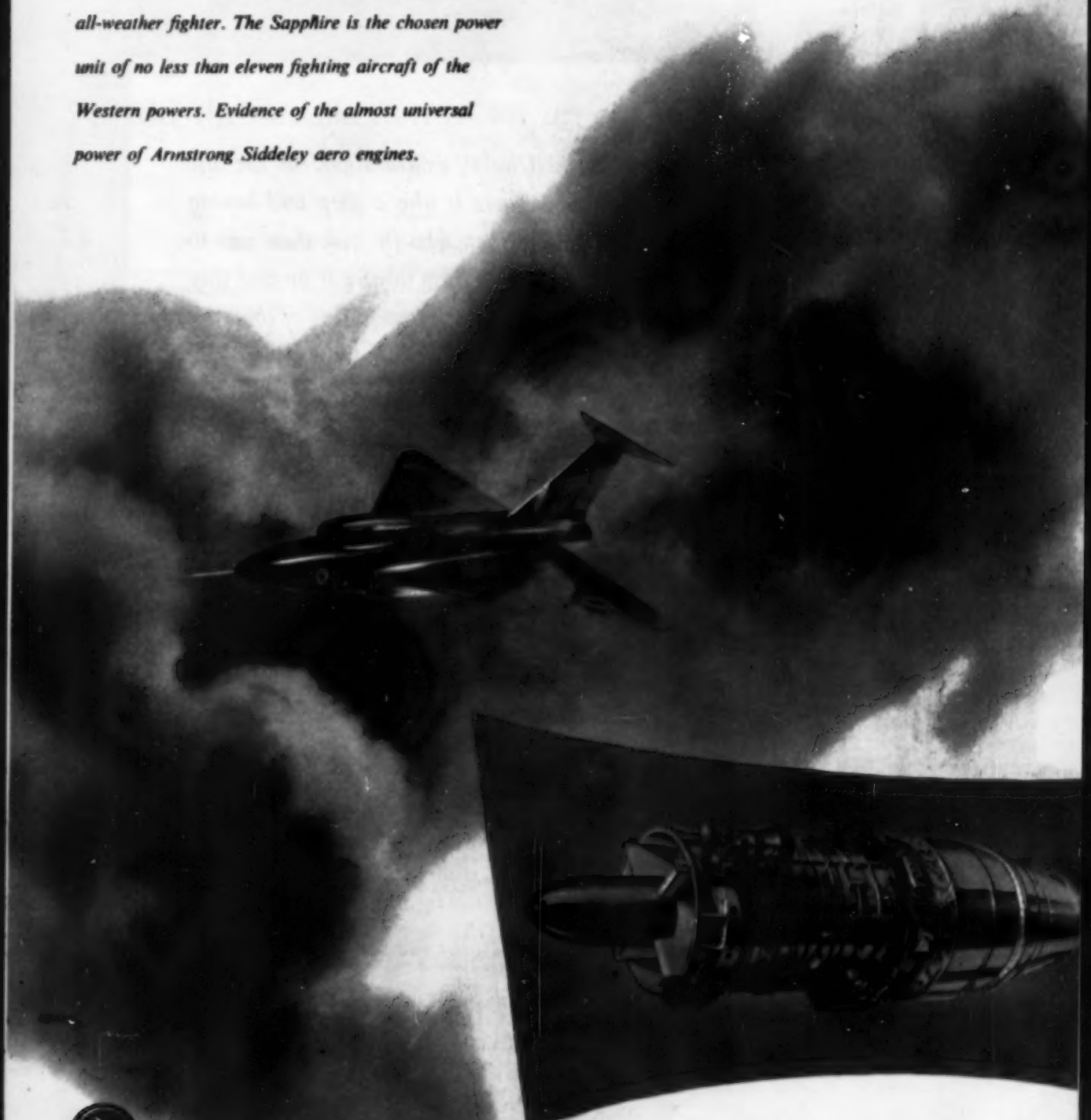

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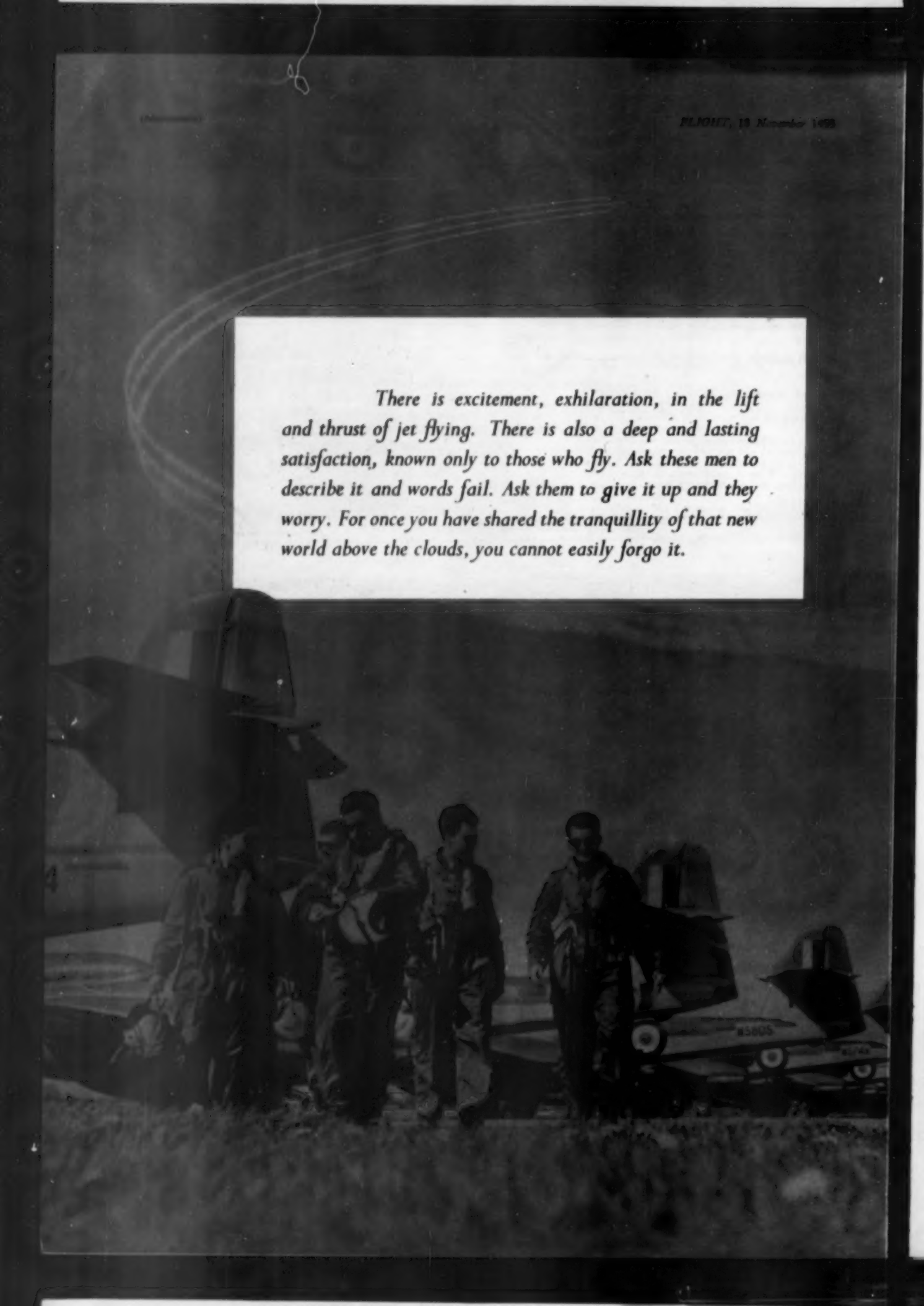

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Taking the salute at Lyneham from a Land-Rover, Air Marshal Sir Donald Hardman, accompanied by S/L. Swift and A.V-M. McKee, drives past No. 216 Squadron's Valettas on their return to England. "Flight" photograph

VALETTAS TO COMETS

No. 216 Sqn. Returns for its New Rôle

ON Thursday of last week No. 216 Squadron returned to England after 38 years' continuous service abroad. Early next year it will take over the first of the Comet 2s now being prepared for service with Transport Command.

The squadron flew its eight Valettas back from Fayid *via* Malta and landed at its new base at Lyneham, Wilts, to be welcomed by Air Chief Marshal Sir Donald Hardman, Air Member for Supply and Organization, and A.V-M. A. McKee, A.O.C.-in-C. Transport Command, with many members of his headquarters staff. All previous commanders of the squadron had been invited to witness its return and many of them came.

No. 216 was first formed in 1917 at Manston as "A" Sqn., R.N.A.S., but a few months later became No. 16 Sqn., R.N.A.S. Finally, six months after its formation, it became No. 216 Sqn., R.A.F. Formed specifically as a strategic bomber unit to attack industrial targets in Germany, it dropped 176.5 tons of bombs in 162 raids before the armistice led to its being employed on mail-carrying to Cologne and Valenciennes. The new rôle was continued when the squadron was moved to Egypt and passengers and mail were flown to Palestine and Iraq.

Equipment then consisted of Handley Page 0/400s (World War I), D.H.10s (1921), and Vimys (1922) before 1925 saw the unit's redesignation as a bomber/transport squadron with Victorias. The Cairo-Baghdad mail had occupied No. 216 for some time when, in 1930, the unit was given the task of surveying the little-used central-African route to Takoradi, which became so important in World War II. Valentias were issued in 1935 and Bombays were coming in in 1939 when war broke out.

When Italy too entered the war the Bombays were hurriedly fitted with bomb-racks and flown against the Italians at Sidi Barrani and Benghazi. For the longer-range sorties at this time four-gallon petrol cans were carried and dumped overboard when the tanks had been replenished.

From 1940 onwards the squadron worked exclusively on transport duties, supporting the movement of squadrons to Greece and being actively employed against the Rashid Ali revolt in Iraq. A party of sappers was flown out to blow up a vital railway bridge on the Syria-Mosul railway. Supplies were flown to Tobruk, and in November 1941 five Bombays made the first Allied airborne landing in North Africa, dropping 54 airborne troops at Tmimi. On July 29th, 1942, the squadron carried fuel to a point 200 miles behind the enemy lines to enable Albacores to refuel and attack an enemy convoy. After the El Alamein battle supplies were carried to Landing Ground 125, 400 miles behind enemy lines, to allow a Hurricane wing to operate from there. A short period with Hudsons followed before the unit was re-equipped with Dakotas in 1943, and it spent the remainder of the campaign supporting fighter wings as they followed Rommel's retreat.

No. 216 Sqn. was at Salerno soon after the landings, bringing in reinforcements, and many sorties were flown in support of operations in the Dodecanese Islands. Four aircraft supplied official transport for the Teheran conference in 1943. During the following year a detachment went to South-East Asia for supply-dropping operations in the Imphal-Kohima area where, in three months, they dropped more than 600 tons of supplies, carried 7,200 passengers and evacuated 500 casualties.

Earlier equipment of No. 216 Sqn. included the Bombay (above, centre) and the Valentia, in one of which Cameron Highlanders are seen embarking at Ismailia in 1938. The Valentia was a developed Victoria.

After the war the unit remained in the Middle East and has since ranged over the Mediterranean and south to Aden and Nairobi. It holds at present the Vickers Trophy for the most efficient transport squadron in the Middle East Air Force.

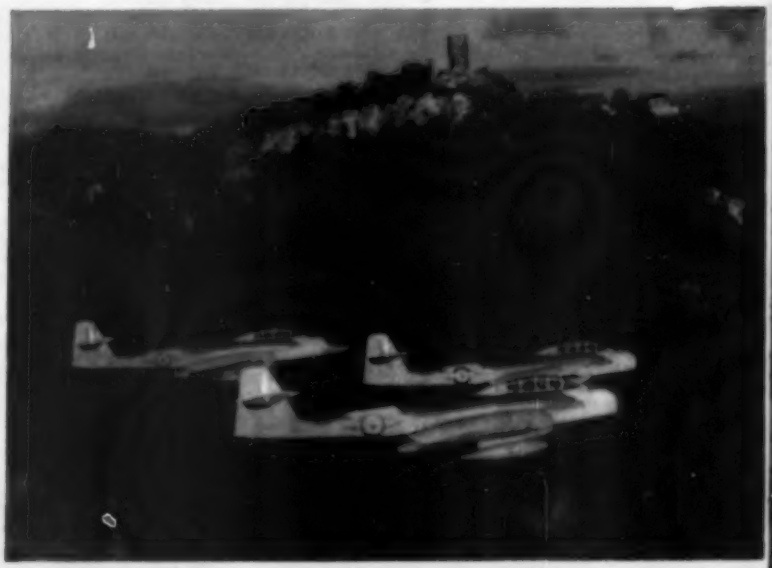
S/L. W. J. Swift brought the squadron back from the Canal Zone to Lyneham, but when the Comets arrive his place as commander will be taken by W/C. B. D. Sellick, who is at present on a course at the R.A.F. Flying College, Manby. The squadron has secured the distinction of returning to England as a complete unit without being disbanded and reformed; this fact, together with the new rôle as the first jet transport unit in Transport Command, will undoubtedly make this, their first full tour of service in England, a memorable episode. As a unit, No. 216 Sqn. was based in England for only four days in 1917 before going to France and, whereas a squadron pilot took eight and a half hours to fly to Cologne and back from his French base during World War I, the Comet 2 will cover almost five times that distance in half that time.

(Left) At Lyneham to welcome No. 216 Sqn. were A.V-M. McKee, A.O.C.-in-C. Transport Command; Air Marshal Sir Donald Hardman, Air Member for Supply and Organization; and G/C. Waterhouse, Station Commander. (Right) A group of the squadron's commanders were assembled for the return, including (l. to r.) G/C. P. Q. Chichester, A. Cdre. C. O. S. Modin, G/C. C. W. Mackay, S/L. W. J. Swift (present commander), G/C. G. R. Howie, W/C. C. M. Foll, S/L. R. T. Mason and W/C. B. D. Sellick (commander designate).

WATCHMEN OF THE RHINE

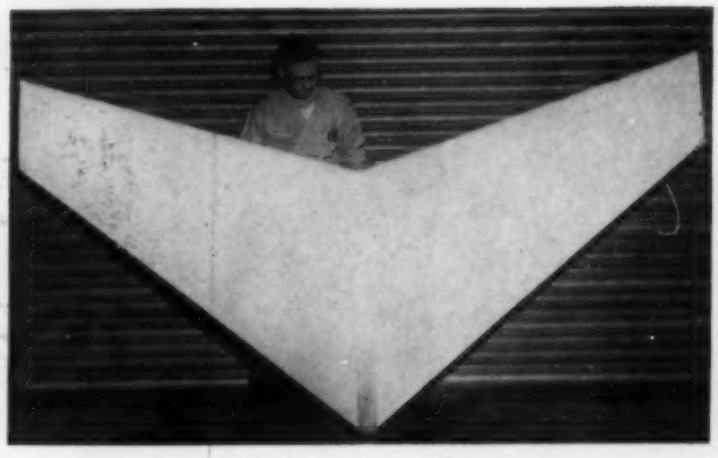
—the Newly Marked Meteors of No. 68 Squadron

RIGHTLY supposing that many of our readers would be interested to see his squadron's recently approved markings, W/C. E. James, D.F.C., A.F.C., Officer Commanding No. 68 Squadron, based at Wahn, Germany, has sent us these pictures of three of the unit's Meteor N.F.11 night fighters. The colours, the wing commander tells us, are dark (Australian) blue, and gold (representing the desert) on an R.A.F. blue background, and they commemorate the formation of No. 68 Squadron at Heliopolis in Egypt during October 1916 —entirely with Australian personnel. In the picture above, Cologne is seen, in the cathedral area at least, to be rising again from its rubble. The three spans of the Hohenzollern bridge are in view and a pair of monster Rhine barges are proceeding upstream under the road bridge to the left. In the smaller picture is the centuries-old ruined castle on the Drachenfels, a short distance up the river from Bonn. In the slopes of the hill is the Drachenhöhle, legendary cave-home of the dragon slain by Siegfried.



Plastic Wing Fabrication

An Admirably Simple Structure, Holding Considerable Promise



Cornell's plastic wing has a smooth surface, and can withstand skin temperatures up to 400 deg F.

PARTICULARLY during the past five years great strides have been made in evolving methods of airframe construction which, while having very competitive strength/weight ratios, are both simpler and cheaper to make than the conventional skeleton-and-skin system. Parallel with this work has gone a wide programme into finding new materials—or in using materials not previously employed in airframes.

Aircraft design engineers have considered many methods which would eliminate the large number of assembly operations necessary in the fabrication of various airframe structures. The present method of fabrication, in which most missile or aircraft structural components are built up of many formed pieces of aluminium, laboriously bolted and riveted together, has been tolerated only because production and structural requirements have never been met by other materials or methods. However, with the challenge of high rates of production of guided missiles, with generally different structural requirements, the work on new materials has gained additional impetus.

The so-called "sandwich" construction contributes greatly to the suitability of plastics for aircraft fabrication. The excellent physical properties possessed by the combination of light-weight core materials with glass-reinforced laminate skins have placed combinations of this type high on the list of efficient structural materials. Not only are their strength/weight ratios high, but they lend themselves to increased production, since in most instances they can be integrally moulded. In order to produce structural aircraft components of glass-laminate sandwich construction, manufacturing techniques will have to be studied and developed so that a satisfactory product can be manufactured at a reasonable rate and cost.

For this purpose, Cornell Aeronautical Laboratory of Cornell University, Buffalo, N.Y., U.S.A., proposed a programme to design and develop a plastic wing for comparison with the KDM-1 (a pilotless drone) metal wing, then currently being made in production from a sandwich construction using an aluminium honeycomb core and aluminium skins bonded together with adhesive. The metal sandwich wings were being fabricated rapidly and economically by the Glenn L. Martin company and offered a challenge, since they went a long way towards reducing the number of assembly operations and man-hours involved in the production of a missile wing.

The U.S. Navy Bureau of Aeronautics awarded Cornell Aeronautical Laboratory a contract for a comparative study based on this proposal. The work on subject contract was set up according to five phases. These comprised investigations into wing design and structure, design of a plastic wing, mould design and construction of a prototype wing, comparative static tests of a wing at the Glenn L. Martin plant, and a final report, including drawings, fabrication techniques and comparison of fabrication time, costs and strength with those for the conventional KDM-1 wing.

Since the skin of the sandwich was restricted to glass-cloth laminate, any new material-development was, of necessity, focused on the core. Satisfactory available core materials are of three types: balsa, honeycomb and plastic or rubber foams. While balsa gives the best results in a sandwich construction on a strength/weight ratio, this core material suffers from the disadvantage that forming it to irregular aerofoil shapes is expensive and laborious. Honeycomb core materials of paper, glass fabric or aluminium foil give excellent sandwiches, but forming to aerofoil shape involves the same disadvantages as those suffered in the use of balsa.

The remaining core materials, in the form of polymeric or elastomeric foams, result in sandwiches of slightly lower structural efficiency. However, if a design can be so devised that a so-called "foamed-in-place" core can be utilized, the expense and labour of forming is eliminated. Tests at Cornell Aeronautical Laboratory showed that a strong plastic sandwich could be built.

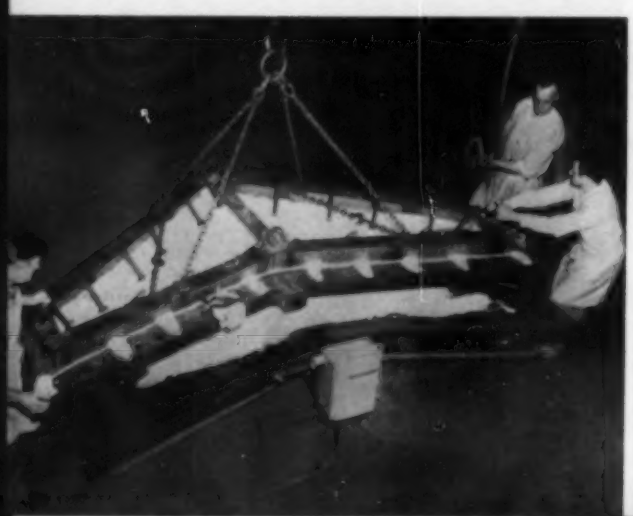
To obtain preliminary structural data that would aid the design, the following tests on sandwich constructions using glass-laminate skins with foamed-in-place cores, were carried out: flat shear, bending to determine foam shear-strength and deformation on bending, influence of discontinuities and restraints, and methods of attachment.

The fabrication of the wing consists of three operations: moulding of the core together with an integral aluminium-rib casting; application and moulding of the glass-reinforced skin; and clean-up of flash and final painting.

A steel mould is used for forming the foamed-in-place plastic core, as shown in one of the photographs. The foam is poured into the mould (which is fitted with a shim of rubber equal in thickness to the skin) and the core is pre-moulded to size and shape. The completed core has a metal centre rib casting, set in the mould before pouring the foam, which acts as an attachment fitting. The core is then covered with a glass-reinforced plastic-impregnated skin, placed in the mould (from which the rubber shim has been removed) and subsequently cured for two hours at 225 deg F, there being strip heaters on the top and bottom halves of the mould. The completed integrally moulded plastic wing is taken from the mould, the flash is sanded off and the wing is painted.

The prototype wing was statically tested by the Glenn L. Martin company and found structurally adequate. It weighed six per cent less than the aluminium-honeycomb/aluminium-skin counterpart, and it was estimated that the man-hours for fabrication were reduced by approximately 30 per cent. The Cornell laboratory considers that a 20-25 per cent reduction in material costs could also be expected. Another remarkable feature of the wing is that it retained its strength well at temperatures of up to 400 deg F.

It is said by Mr. Norman Wahl, head of Cornell's Wood and Plastics Section, that a considerable reduction in assembly operations and man-hours has now been achieved in the fabrication of this wing, and further research has been requested.



This photograph shows the upper half of the steel mould being removed after forming the core to the interior profile of the wing.

BENTLEY PRIORY

Headquarters Fighter Command: an Historic and Dignified Building

SINCE 1926, when it became the home of Headquarters Inland Area, a part of the Air Defence of Great Britain, Bentley Priory has been associated with the air defence of this country. It achieved its present status of H.Q. Fighter Command in July 1936 when the Command itself was formed and the headquarters moved from Hillingdon House to the Priory. The first A.O.C.-in-C. was Air Marshal Sir Hugh Dowding, now Lord Dowding of Bentley Priory.

But Bentley, a name formed by the agglomeration of the Saxon words beonet, meaning coarse grass, and leah, meaning uplands, has a history connected with the defence of Britain in the very earliest times. In fact, when Queen Boadicea was defeated by the Roman general Suetonius nearby, she took poison, and it is thought that she was buried somewhere in the grounds. In the twelfth century the Priory itself was founded and the land came into the possession of various people, before Henry VIII gave it to private owners in 1546. One of the most distinguished periods in its existence came in the 18th century when John Hamilton, the first Marquis of Abercorn, built the nucleus of the present house. At the turn of that century it was a famous rendezvous for statesmen and men of letters. In 1882 the Priory became a private hotel served by a special extension of the railway from Wealdstone to Stanmore; and then for some years it was a girls' school. Finally the estate was broken up, and the part which includes the Priory was bought by the Royal Air Force.

Yet, though the exigencies of war led inevitably to various unpleasant modifications to the fabric, a great deal has been done since the end of hostilities to restore to the Priory something of the dignity it once knew.

After a fire in 1947 had destroyed the ante-room and some offices above it, this part of the building was rebuilt by stages. The ante-room had already suffered to some extent by having to accommodate the Command's filter room and plotting centre at the beginning of the war, but it is now well restored. In 1949 a new bar was built beneath the ante-room, in the sub-basement and, in 1953 a new conference room was also built on the second floor above it. Last year, stripping of the camouflage paint from the exterior of the building and restoration of the facing were begun. This work is now almost complete; and the mess kitchen and servery have also been extended and modernized and the main dining room enlarged and rebuilt with a new roof.

More historically important, however, has been the housing of a number of relics and documents and the building up of a gallery of pictures of considerable merit. Models of most of the fighters used since the R.A.F. was formed, together with some of the equipment required for them, are on view in a large glass case at the entrance. Opposite are a number of silver trophies. Here also is kept the book containing a complete set of photographs of the Royal Review of 1953, together with the names of every pilot who flew in the great fly-past, and his place in his formation.

Further on, the main hall contains the flags of the seven Allied nations whose pilots fought in Fighter Command during the war, and record boards list the names of all past principal staff officers and commanders. There is a fine drawing by Sir Roderic Hill of Bristol Fighters during World War I, presented to the Command

The exterior of the Priory—camouflaged during the war—has been almost completely cleaned and renovated (top). Other views, from top to bottom, show the rebuilt dining room with its paintings; the rotunda with the seventeen bedroom and portraits; and the underground bar, here tended by L. Gane, barman for the last seven years. The badge below the heading is that of Fighter Command.

The fuel goes 'round and around

Between the arms of this ENGLISH ELECTRIC test rig at Warton there is room to put the fuel system of a modern jet aircraft—full size, and complete with all tanks, pipes, pumps, vents and cocks.

From the tanks can be pumped fuel at any desired rate up to that representing the full throttle take-off condition. Into it can be pumped simultaneously enough fuel to keep the level at any required point—thus maintaining steady conditions of test.

And while all this pumping and counter-pumping is going on, the entire outfit can be rotated bodily through any required angle, at any required rate of rotation (within limits), thus simulating as nearly as may be the effect on the fuel system of high-speed manoeuvres in flight.

If the test rig proves that the calculations of the ENGLISH ELECTRIC test team were correct—well and good. If not—how much better that defects should be shown up on the ground than in the air! In this open-minded atmosphere the long, costly and elaborate testing on the ground does a lot to shorten the much longer, and certainly more dangerous, process of trial and error in the air.

'ENGLISH ELECTRIC' aircraft

THE ENGLISH ELECTRIC COMPANY LIMITED
QUEENS HOUSE · KINGSWAY · LONDON · WC2

Design starts from an attitude of mind

A typical Dunlop Hydraulic Brake circuit with associated components is illustrated on the opposite page.

DUNLOP

HYDRAULIC BRAKES
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for high-performance
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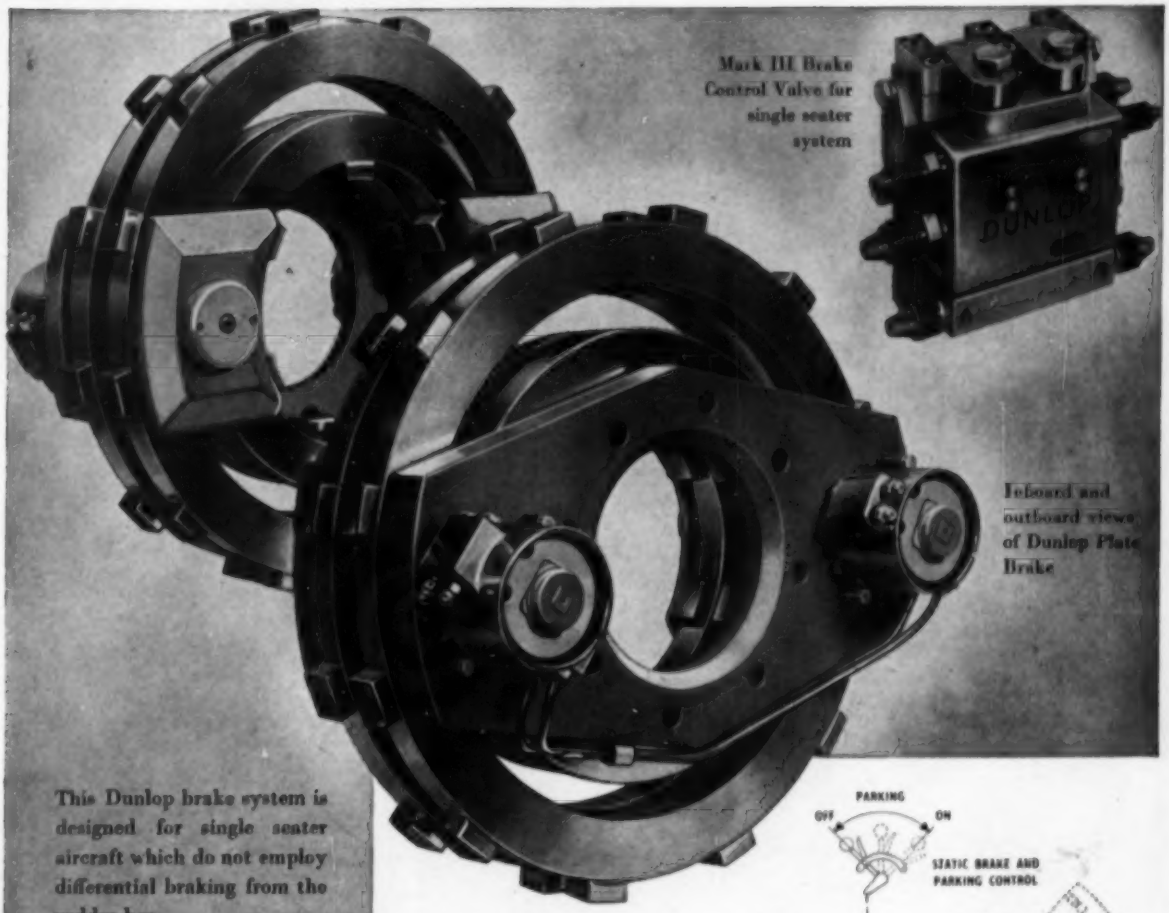


Mark III Brake Control Valve for single seater system

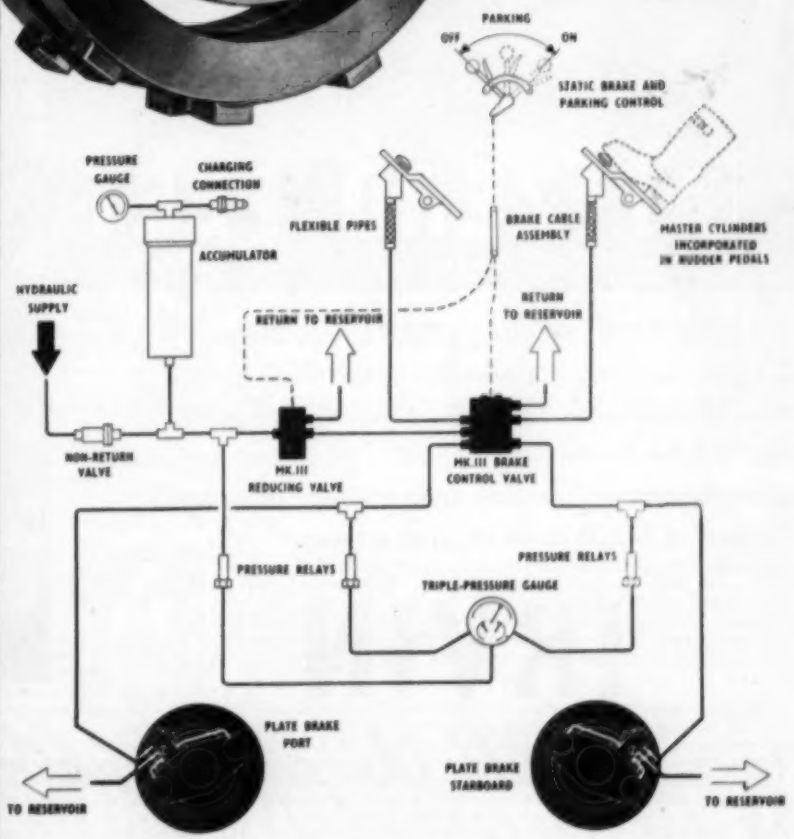
Inboard and outboard views of Dunlop Plate Brake

This Dunlop brake system is designed for single seater aircraft which do not employ differential braking from the rudder bar.

Normal braking is carried out by the operation of master cylinders attached to the rudder pedals.

Cable operation of the Mark III pressure reducing valve permits the use of increased pressure during engine 'run up'.

Mk III Control valve —reducing or parking



"The Aeroplane" photo.

MAGNIFICENT ACHIEVEMENT—On September 3, Sqn. Ldr. Fifield made the first live zero-feet ejection in a Martin-Baker Patent fully Automatic Ejection Seat from a Meteor 7/8. The IRVIN 24-feet parachute used was of the same canopy design that saved the lives of 30,000 airmen during the war.

IRVIN

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BENTLEY PRIORY . . .

by the Royal Drawing Society, and the original coloured drawing of the Westminster Abbey Battle of Britain memorial window by Hugh Easton. Of great historical value are framed originals of two letters from Lord Dowding to Lord Balfour, then Under-Secretary of State for Air. One, dated October 2nd, 1940, is in reply to congratulations on its writer's appointment as G.C.B. Lord Dowding says that if he could he would tear the distinction into a thousand pieces and distribute them to those who, he felt, had really won it. The other is dated May 16th, 1940, and, addressed also to Lord Balfour, notes that fighter strength is reduced to 36 squadrons, instead of the considered minimum of 52 squadrons. It foresees the necessity of defence against air attacks coming from the French coast as well as from Germany and asks that no more fighters should be sent abroad. The forecast of the outflanking of the air defence front was at that time disbelieved; but the subsequent German occupation of France and their full use of air bases there proved the forecast completely correct.

The rotunda is lined with the badges of 58 squadrons which took part in the Battle of Britain and is hung with portraits, by Eric Kennington, Cuthbert-Orde and William Dring, of many of the Battle's aces—"Sailor" Malan, Stanford Tuck, "Johnny" Johnson and Sir Harry Broadhurst among them. Similar historical material in the form of combat reports dating from 1915 to 1943 and signed with such names as J. M. Robb, W. S. Douglas, McCudden, Mannock, Portal, Johnson and Cunningham, hang on the walls of the conference room. In less serious vein are the caricatures of past members of the headquarters, hung in the passage from the ante-room to the bar.

With such material, the principal rooms of Bentley Priory have once again taken on some of the colour and grace of an old country house, and it can be said that the work which has been done in the last three years has gone far towards restoring the dignity of the Priory. There is little evidence in the building itself of the operational tasks which are performed in the headquarters as a whole, because, fortunately, the more warlike activities are carried on in special buildings, under or above ground, which have accumulated in the park.

Most impressive of all the rooms, however, is the newly-decorated dining-room which has been turned into something of an art gallery. It contains a number of fine paintings, including a portrait of the Queen by Denis Fildes and the large picture by Roy Nockolds, *A Day in the Battle of Britain*, showing a German mass raid being intercepted over the Isle of Sheppey. The original of the famous *Looking for Trouble* picture by Frank Wootton is there, together with other originals of his excellent war-time paintings. Pictures by Frank Beresford and Pamela Drew are also displayed. Though certain of the works are on loan from the Imperial War Museum, most of them belong to the H.Q., a few having been presented by well-wishers in the aircraft and oil industries. None has been bought with public funds. This collection, in common with the other features of the house, is a real contribution to the historical record of Fighter Command, and something of which the R.A.F. may be justly proud. It is the basis on which the already worthy traditions of the Command are being steadily developed.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

The Vickers Victoria

I WAS very pleased to see a photograph of a civil version of the Vickers Victoria in the issue of *Flight* dated October 21st. These machines were extensively used by No. 70 Bomber Transport Squadron during the time they were situated at Hinaidi, Iraq.

The Victoria's interior, with hammock-type seats lashed back. Note the cockpit.

The earlier type was made of wood, but a later type was of metal. The power units were two Napier Lions, as stated, but later there was one powered by Bristol Jupiters. This marchine was exceptionally fast compared with the others, and was piloted by the commanding officer of No. 70, the late A.V-M. (then W/C.) Blount. This Jup-Vic crashed in a sandstorm and was a complete write-off. Fortunately no one was hurt. One of the enclosed snaps shows the interior of one of the Victorias and seating arrangement.

J. T. BENNETT.

Darlington.

Squadron History

I WAS delighted to see, in the October 28th issue of *Flight*, that you have once again met the requirements of those of us who are interested in squadron histories. You certainly perform a valuable service to us and I, for one, greatly appreciate it.

There is one aspect of your histories which concerns me, however, and it is rather striking in the 100 Squadron history; namely, the lack of photographs of the squadron between 1935 and 1955, a gap of 20 years. Something similar is evident in your previous history, that of No. 47 Squadron in the April 8th issue. I have found the same thing in building up my own photographic collection on each unit. Very few photos of squadron aircraft are available for the period of 1938 to 1947 for almost any of the R.A.F. squadrons.

In an attempt to reduce the gap in the 100 Squadron history by a year or two I enclose a negative depicting one of the squadron's Lincolns at the Coronation Review at Odiham in 1953. [We regret that we have not space to print this photograph, which shows a Lincoln bearing the serial RE411, with RA665 in the background.—Ed.]

For the information of any of your readers who are interested in insignia, No. 100 Sqn. was allotted the code letters "RA" in 1938-39 but whether they were ever carried on the Vildebeests has never been confirmed. After re-forming, the squadron's Lancasters were coded "HW," which was painted in red on the fuselage sides. This was retained by the Lincolns after the war, but in white, until code letters were discarded for operational units in 1950. Soon after, the large serials were adopted.

Epsom, Surrey. JOHN D. R. RAWLINGS.

Glider Towing

I WOULD like to draw your attention to a misprint in the excellent article entitled "Tug and Glider," by Mr. P. W. Brooks, which appeared in your issue of November 4th. The size of the nylon rope normally used for towing gliders is ¾in circumference and not ¾in as printed in this article.

The Certificates of Airworthiness of both tug and glider prohibit the use of a rope with a breaking strength of more than 1,000 lb, and as ¾in circumference nylon rope breaks at about this figure it is normally used. A thinner rope would soon become too weak, while anything stronger would necessitate the use of a weak link.

Farnham, Surrey. LORNE WELCH.

IN BRIEF

Mr. C. J. Robins sends a photograph of his three-wheeled car, which is propelled by a 3ft-diameter airscrew. The latter is—or was—the windmill used to drive the target-cable winch on a Miles Master. Our correspondent (whose address is Vicarage Street, Yeovil, Somerset) wishes to obtain another propeller of the same type, or to know who the original manufacturer was.

* * *

Two Dutch students taking the aeronautical course at the High Technical College in Haarlem write to say that in their fourth year, which is a practical one, they hope to spend three months in the Fokker factory and six to nine months at an aircraft works in Great Britain. They have a fairly good knowledge (conversational and technical) of the English language, and would like to know if there is any factory willing to receive them. The letter is signed by L. G. A. Lutter, c/o Veenbergstraat 2, Haarlem.

THE INDUSTRY

Towards Instrumental Perfection

SHOWN in the heading illustration is the interior of a new building recently added by R. B. Pullin and Co., Ltd., to their works on the Great West Road, at Brentford, Middlesex. It has been designed to provide conditions which are, as nearly as humanly possible, ideal for the assembly and test of gyroscopic and other precision instruments. Certain other processes demanding a very high degree of cleanliness, e.g., lens blooming, will also be conducted in the new department.

In order to prevent the entry of dust, the building is air-conditioned, pressure-controlled and fitted with air locks. Filtered air enters the working space through ducts in the roof, and is withdrawn through vents at floor level. Ten changes of air are circulated every hour, and any desired proportion of volume can be filtered and re-circulated.

When work is not in progress, the air conditioning system can be shut down and an even temperature of 65 deg F maintained by a hot-water radiator system.

In order to reduce heat losses and condensation, a system of air-spaced double roofing is employed, supported by welded-steel portal frames. The floor of the working area is covered with Roflex latex compound, which will stand up to the hard conditions of use and provide a resilient yet dust-free surface.

A high and even intensity of shadowless illumination is conferred by the daylight admitted through "pavement lights" mounted in the ceiling, and by a particularly neat installation of continuous-trough fluorescent lighting fittings.

Power supplies at four different D.C. voltages and several A.C. voltages at five frequencies are distributed *via* an underfloor system, and access to any supply can be obtained anywhere in the building by removing the nearest floor cover.

In order to avoid risk of dust and lint from clothing, nylon coats are provided for the use of employees and visitors. Special precautions are also taken to prevent danger of corrosion of instrument components. In this connection, experiments are being made in the wearing of nylon gloves.

New Plessey Company

THE Plessey Group announce the formation of a company to control the establishment and development of a number of new enterprises in Great Britain; it is to be called the Plessey Development Co., Ltd.

In recent years the group has been playing an increasingly active part in the field of Anglo-American trade. The new company, which is being staffed with a number of senior engineering and production personnel specially engaged for the purpose, is to be an administrative unit designed "to provide and blend American abilities in design and production with the Plessey Group's extensive production capacity."

The directors of the new company are Mr. A. G. Clark (chairman and managing director), and Messrs. E. J. Earnshaw and A. E. Underwood.

Faithful to Engines

IT is announced by Air Engine Services (U.S.-U.K.), Ltd., of Blindley Heath, Lingfield, Surrey, that Mr. G. A. Hummerstone, engineering manager of the B.O.A.C. repair factories at Treforest until his retirement last March, has joined the company's Board. During his 40 years in aviation—he is now 61—Mr. Hummerstone has dealt with some 70 different models of 35 types of engine, both British and American, ranging from 80 h.p. to 3,500 h.p. He first worked for the Westinghouse Brake and Signal Co., Ltd., and joined the R.F.C. as a fitter in 1915. He went to the Aircraft Manufacturing Co. in 1919 and later became foreman in charge of engine overhaul and repair for Aircraft Transport and Travel, Ltd. He subsequently worked for Instone Airlines, and then for Imperial Airways. At the outbreak of war he played an important part in the establishment of B.O.A.C.'s engine-overhaul works at Treforest.

Mr. G. A. Hummerstone.

A section of the new R. B. Pullin building (see Col. 1).

Chloride Developments

TWO new types of Exide cell have recently been evolved by Chloride Batteries, Ltd., of Clifton Junction, Swinton, Manchester. The first is a two-volt cell of unusual design, primarily for use with the vibrator power packs of portable radio equipment for the Armed Services; it can also be used for other similar applications and where high-rate discharges with relatively high terminal voltages are required. The cell is assembled in a robust container moulded in polystyrene, and the lid, of the same material, is cemented in position by a technique which produces a reliable leak-proof joint. Within the cell, the nine positive and ten negative pasted plates are separated by sheets of Porvic and resin-bonded glass wool, the latter positioned directly against the surfaces of the positives. Filled and bench charged, the Exide type ZVP19 cell weighs 3 lb and measures 3⅞in long by 2⅝in wide by 4⅝in high. The charging rate is 2 amp.

The second development, the Exide Z2H11, is a new cell claimed to operate efficiently without electrolyte spillage at the greatly reduced atmospheric pressures encountered in stratospheric flight. Of lightweight design, it will be used in batteries of three to provide about 6.75v to power the metering and telecommunication equipment of the radar-sonde Mk III meteorological balloon. The basic construction of the cell element is similar to that of the normal lead-acid battery, and is assembled in a polystyrene container. A cell weighs approximately 9½ oz dry and 13½ oz primed, and each is 1 3/32in wide by 3¾in long by 4 3/16in high (approx.).

IN BRIEF

Mr. L. G. Carpenter has recently been appointed managing director of Integral, Ltd., the well known Wolverhampton manufacturers of aircraft hydraulic and other equipment. He spent 18 years with the Gloster Aircraft Co., Ltd., and has been general manager of Integral, Ltd., for the past eight years.

* * *

We regret to record the death, at the early age of 56, of Mr. R. L. Potter, who had been on the staff of Elliott Brothers (London), Ltd., for 22 years. He worked in the test room until 1930 and then joined the heat control division, later becoming service engineer of that division and then service manager. At the time of his death he was divisional sales manager.

* * *

A new research and development establishment has been opened at the Bracknell, Berks, aircraft equipment department of Ferranti, Ltd. It will primarily be concerned with the development of systems and components for aircraft electrical equipment and instrumentation, with particular reference to gyroscopic and associated navigation systems. The chief engineer is Mr. W. A. Mallinson, and the chief research engineer Mr. J. W. Barnes, late of the R.A.E., Farnborough.

* * *

By the end of 1957, the two largest electric furnaces for steel smelting in Britain will be housed side-by-side in the Stocksbridge works of Samuel Fox and Co., Ltd., associates of the United Steel Companies, Ltd. The first furnace—now tapping 70 tons—was installed last November and is stated to have proved to be an outstanding success. The new furnace, which will be of similar capacity, forms the central feature of a £2,845,000 development scheme on which work is just beginning. It will result in a substantial addition to the tonnage of special and alloy steels available each year for use for the aircraft, motor and other industries.

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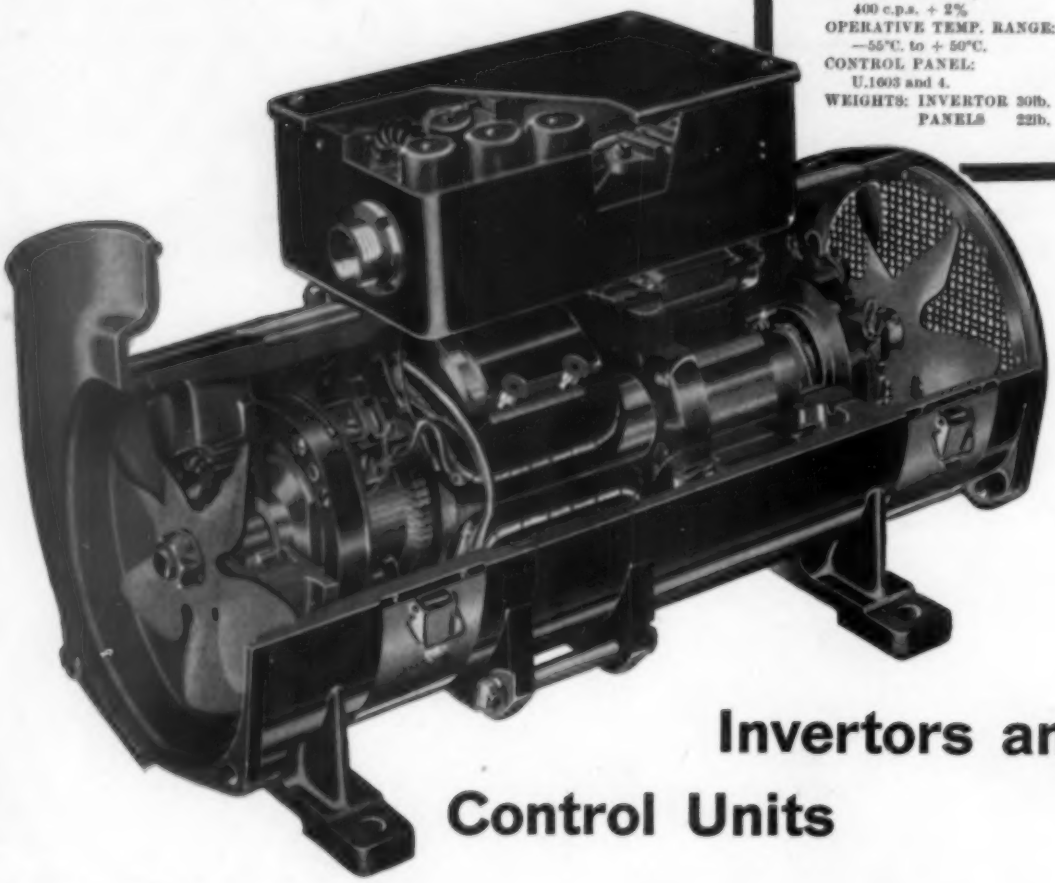
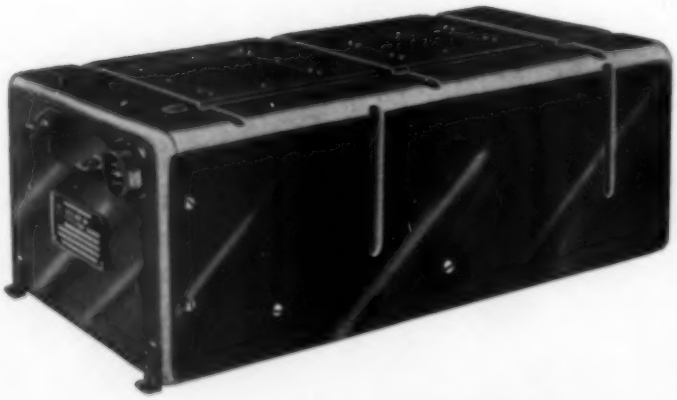
INPUT: 100-116V. D.C.
OUTPUT: 115V. + 2% 3 PHASE, A.C.,
750W. at ·8 P.F.,
400 c.p.s. + 2%
OPERATIVE TEMP. RANGE:
—55°C. to + 50°C.
CONTROL PANEL:
U.1603 and 4.
WEIGHTS: INVERTOR 30lb.
PANELS 22lb.



Invertors and Control Units

ROTAX manufacture a wide range of invertors for all forms of aircraft applications. These invertors, used in conjunction with control panels which incorporate a tuned frequency detector, balanced voltage bridge and magnetic amplifiers, maintain an almost constant voltage and frequency output, irrespective of load and input voltage variations. Both units are extremely robust and are fully suppressed. Using additional control equipment transient overloads of 100% can be handled quite satisfactorily. Full information available.



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CIVIL AVIATION

DECISION FOR DECCA

IN a statement issued earlier this week, British European Airways have announced their decision to adopt the Decca Navigator system as their standard short-distance navigational aid. The decision to equip all B.E.A.'s mainline aircraft with Decca, including 19 Elizabethans in service and the 22 Viscount-Majors on order, follows long theoretical study and a large-scale practical trial of the aid, which is fitted in all the 24 Viscounts now in service with B.E.A. B.E.A.'s operational experience with Decca thus amounts to some 30,000 hr.

After referring to the inadequacy of the present system of non-directional beacons and/or radio-ranges in conjunction with radio-compasses, the B.E.A. statement says that for some years the Corporation has been seeking an alternative which would "meet the current and foreseen needs of air navigation (and simultaneously the needs of the air-traffic control system) and also provide a stable situation over a reasonable economic life." The economic aspect could be a decisive factor, particularly where national budgets were such that it was often difficult to achieve full deployment of such important facilities as I.L.S. Decca, in addition to being the only aid promising to meet the stringent requirements of helicopters, was already in general use as an aid to shipping and survey. The decision to adopt it, the statement said, was subject to the fulfilment of certain requirements "which we are confident will be met."

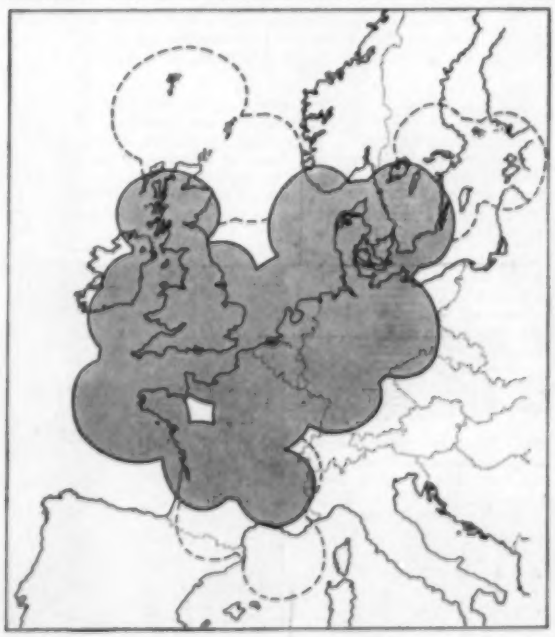
Some of the advantages of the Decca system are summed up by the flight operations department of B.E.A. as follows:—

"It enables a pre-determined track to be maintained precisely and E.T.A.s to be calculated easily and as frequently as desired with a degree of accuracy which we do not believe capable of achievement by any other contemporary system.

"The Flight Log has proved invaluable for detecting the sudden wind changes which are frequently encountered at the higher flight levels. Experience has shown that unforecast winds are frequently of the order of 100-120 kt and if undetected could result in the aircraft's being a considerable distance away from the estimated position. An early indication of strong adverse headwinds has frequently enabled us to select a more favourable altitude and thus avoid the necessity to make a technical stop for refuelling.

"In the terminal area applications, the Flight Log has proved most useful from the standpoint of the ease and accuracy with which it is possible to maintain holding procedures, and in ensuring a smooth and rapid transition from the holding pattern to the feed-in point associated with the particular final approach aid to be used. Taking advantage of Decca we have found it possible, in the London area in particular, where traffic conditions have permitted, to shorten the normal approach procedures by using the Flight Log to feed directly on to the final approach aid.

"In general, pilots are enthusiastic about the Flight Log type of display and consider that it can ease the cockpit work-load considerably. We believe that Decca is the most promising aid for the development of procedures using lateral separation, which will become increasingly necessary as traffic density builds up at the higher altitudes. The flexibility of the system, with its area coverage, enables alternative and in appropriate cases more direct routeings to be established. This is a most valuable feature, particularly where turbine engined aircraft are involved."



As reported above, Decca has been chosen as B.E.A.'s standard navigation aid. Present Decca coverage of Europe is shown by the tinted area of this map; the broken lines enclose areas to which it is planned to extend coverage.

The Decca receiver which B.E.A. propose to adopt as a standard fixed-wing aid, the Mk. 10, will incorporate zone-identification facilities and automatic lane identification, effectively producing a "one-shot" system.

B.E.A. also intend to fit V.O.R., though with the proviso that "D.M.E. will probably never be provided in Europe, particularly in the light of the recent TACAN developments and that V.O.R. deployed in Europe will in the main provide only airways track guidance of less than optimum quality." This step was necessary in order to comply with I.C.A.O.'s "by-either-of-two-means" requirement, since full Decca coverage would not be immediately available on all B.E.A.'s routes. Standard equipment would thus comprise one Decca receiver Mk. 10, including the Flight Log, one V.O.R. receiver and one A.D.F. receiver.

B.E.A.'s announcement follows the recent M.T.C.A. statement of United Kingdom short-range navaid policy (*Flight*, October 28th) which affirmed that "of all existing systems, Decca best meets the A.T.C. requirements for navigation on the U.K. national airways and in control zones."

NATIONAL AIRLINES BUY DC-8s—

WITH the announcement of National Airlines' decision to buy six DC-8s, the backlog of orders for the Douglas jet transport now stands at 61 aircraft having a total value of $372m (£133m). The president of National Airlines said last week that delivery of his DC-8s would begin in midsummer 1959 and that the aircraft would enter service in November of that year. Including spares, the six aircraft would cost $37m (£13.2m)—representing an investment of £2.2m each. Other DC-8 purchasers are Pan American (25) and United Air Lines (30).

—AND A.A. CHOOSE THE BOEING

THE battle of the big jet transports took a surprising turn on November 9th, when American Airlines announced their decision to buy 30 Boeing 707s. This news followed closely a statement that both the Boeing and the Douglas jets were under evaluation by A.A.

The surprise lies in the fact that American thus appear to have ended their long and fruitful association with Douglas—a relationship which produced the historic DC-3 and, more recently, the DC-7. Earlier this year A.A. became the first purchaser of the Electra; they are the second airline to buy the Boeing 707, PanAm having previously placed an order for 20.

On the basis of traffic, American can claim to be the world's leading airline, and the company has long prided itself as a pacemaker in U.S. domestic air transport. One of A.A.'s major competitors, United Air Lines, recently announced an order for 30 DC-8s, for introduction to service in November 1959. American have now stated that their Boeings "will operate the first transcontinental service with turbojet aircraft, and that service will be in daily operation on June 15th, 1959." Mention of the actual day on which it is proposed to begin daily services nearly four years ahead stresses the importance of the competitive influence on United States airline procurement policies. In view of the United order, delivery date may thus have been the deciding factor influencing A.A.'s choice of the Boeing.

The total value of the American Airlines order is quoted as $135m (£47m), the approximate cost of the aircraft being $4.5m (£1.6m) each. The power units will be civil versions of the J-57, and first deliveries are due in March 1959.

MISSIONS TO MOSCOW

TWO British civil-aviation parties left London Airport last week for discussions in Moscow. The first delegation—from the M.T.C.A.—set off on November 9th. It was led by Sir George Cribbett, the Deputy Secretary, who was accompanied by Capt. V. A. M. Hunt, head of the Ministry's control and navigation directorate, and Mr. L. S. Mills, an assistant secretary. It was stated that the object of the visit was to discuss improvement of air communications between Britain and Russia.

A second delegation—from B.E.A.—left London two days later. The party consisted of Lord Douglas of Kirtleside, B.E.A.'s chairman, accompanied by Lady Douglas, and Mr. P. C. F.

A DC-3 of Don-Air Services, Ltd., was the first British aircraft to use the new airport, opened last month, at Flesland, Bergen. Its crew—(left to right) 1st/Off. Sutton, Capt. Watson, Rad/Off. Shirmer, Stewardess Fraser and F/Eng. Diamond—are seen with Mr. N. Gjestland (right), whose company chartered the flight on behalf of a shipping firm.

CIVIL AVIATION . . .

Lawton, commercial director of B.E.A. Lord Douglas said that the purpose of his visit was to discuss the terms of a proposed interline agreement with Aeroflot, with possible connections at Helsinki and Berlin.

REPLACING T.A.A.'s DC-3s

PURCHASE and successful adoption of the Viscount by Trans-Australia Airlines has not reduced the company's interest in the DC-3 replacement problem. This is made clear in T.A.A.'s latest annual report, which emphasizes that "the low density of population in many of the areas served by T.A.A. will for many years to come require aircraft with a load capacity similar to that of the DC-3, if a reasonably high frequency of service is to be operated at an economically acceptable payload."

The report mentions T.A.A.'s interest in the Handley Page Herald and Fokker Friendship, adding that intensive flight-testing of both types during the coming year would enable a more positive assessment to be made of their relative merits as DC-3 replacements. At the end of the 1954-55 financial year T.A.A. were operating 22 DC-3s.

BREVITIES

A REWARD of $25,000 (£9,000) has been offered by United Air Lines for "information leading to the arrest and conviction of the person or persons responsible" for the loss of one of the company's DC-6Bs on November 2nd. An explosives expert was called in to investigate the accident, which, according to reports, followed an explosion in the air. All 44 persons aboard the aircraft were killed.

* * *

In the financial year ended June 30th 1955, Australian National Airways carried 700,000 passengers and 43,000 tons of cargo. The proportion of freight traffic carried by A.N.A. is unusually high, as further emphasized by the report that the airline's Melbourne freight terminal handles 100 tons daily, and that the corresponding figure for Sydney is 60 tons.

* * *

Flying hours logged by the Boeing 707 stood at 319 hr 12 min on November 9th; since it was first airborne on July 15th last year, the aircraft has made a total of 231 flights. In recent weeks the 707 has made demonstration flights for 71 executives of 12 different airlines. Fifty of these airline representatives have sampled the controls in flight or on take-offs and landings.

* * *

K.L.M. have decided to use the Smiths S.E.P.2 autopilot in their fleet of nine Viscount 803s, following "an extensive technical evaluation." This is the first time, say Smiths, that the Dutch airline has specified a British autopilot for its aircraft.

* * *

Mr. Robert L. Baer has been appointed senior technical representative of the United Aircraft Export Corporation, with headquarters in London. He was formerly assistant chief of airline engineering, United Aircraft Service Corporation.

* * *

Mr. D. Koeleman, general manager of K.L.M., stated in New York last week that "informal discussions on the question of landing rights in Moscow and chief cities of the Balkans and Poland" had been in progress between K.L.M. and the Russian government since the opening of the Geneva conference.

* * *

The appointment of Mr. Thomas J. Harris as director of cargo sales is announced by American Airlines. Mr. Harris, who will be remembered in London as European cargo sales manager for A.O.A., succeeds Mr. Joseph D. Boylan, who has resigned.

* * *

A bilateral air-services agreement was signed between Burma and Communist China on November 8th, providing for two services weekly between Rangoon and Kunming by both the Burmese and the Chinese airlines. Signatories to the agreement, which was concluded in Rangoon, were U Win Maung, Burmese Transport Minister, and Wu Fah Sien, leader of the Chinese delegation.

* * *

There are 349,729 active pilots in the United States, according to a recent C.A.A. survey. The survey breaks down the total into percentages represented by 10 different age groups, as follows: 16-19 years (2.91 per cent); 20-24 (11.31); 25-29 (21.06); 30-34 (25.59); 35-39 (17.16); 40-44 (10.21); 45-49 (6.28); 50-54 (3.24); 55-59 (1.48); 60 and above (0.76).

* * *

The operations group of B.O.A.C. is to publish a magazine providing technical information for the Corporation's flying staff. It will be edited by Mr. Derek D. Dempster, a R.Aux.A.F. pilot and former air correspondent of the *Daily Express*.

* * *

The Merchant Air Service was represented at the Westminster Abbey Remembrance Service on November 6th by an independent-airline pilot—Capt. A. N. Marshall, of Skyways, Ltd.

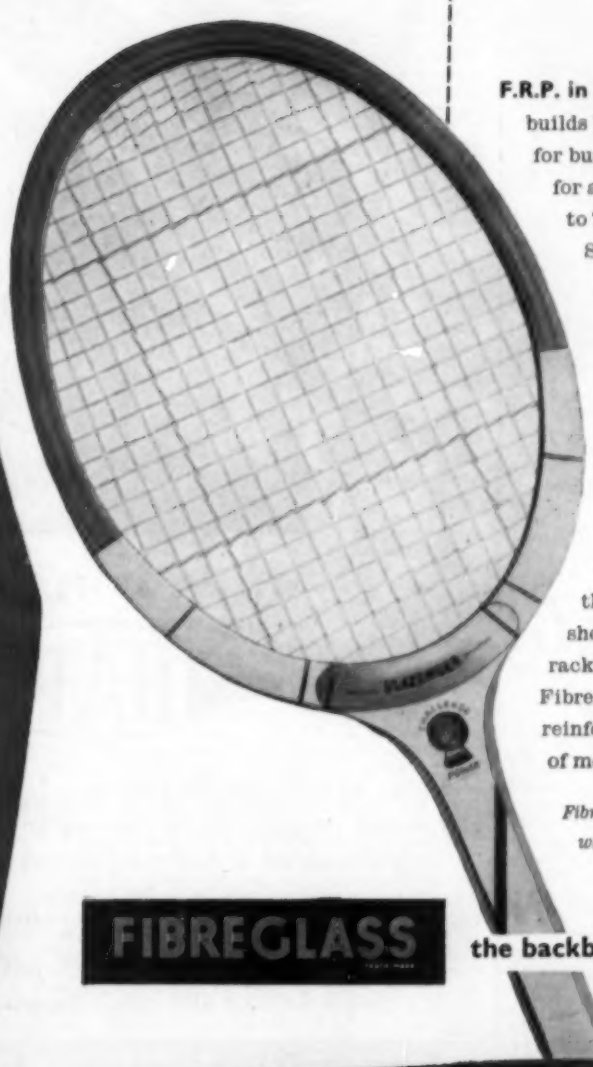
* * *

Canadian Pacific Airlines announce the appointment of Mr. Hugh B. Main as executive assistant to the president. His post of general traffic manager is taken over by Mr. H. Bryan Renwick, who joined the company last April as assistant to the president. Another C.P.A.L. announcement says that the airline last week inaugurated a weekly DC-6B service between Toronto and Lima, Peru, which is already served by a weekly C.P.A.L. service from Vancouver.

(Left) G. W. McConachie, president of Canadian Pacific, is seen at Vancouver signing his company's recent order for three Britannia 300 L.R.s. Looking on is the sales manager of Bristol's aircraft division, Mr. W. R. Farnes (left).

Mr. Stanislaw Krzyczkowski (right), technical director of I.A.T.A., has recently been awarded the Flight Safety Foundation Award for "outstanding contributions to the safety of civil air operations throughout the world." A former technical director of the Polish airline LOT, he joined I.A.T.A. in 1945.

Moulding the future . . .



F.R.P. in new power racket. F.R.P. builds bonnets for cars, body panels for buses, hulls for boats, even bows for arrows. *Now* what is F.R.P. up to? It is putting the power into Slazenger's Challenge *Power* racket. Listen to what Slazengers themselves have to say:—"In developing the new Challenge rackets, a long series of laboratory and playing tests were conducted with experimental frames of different construction. These tests showed that the nearly perfect elasticity of glass fibres could be made to contribute greater speed on the ball without loss of control by quickening the recovery, after impact, of the shoulders—the power-point of the racket." Here is another case of Fibreglass making history: yet another reinforcement to its claim as the backbone of modern reinforced plastics.

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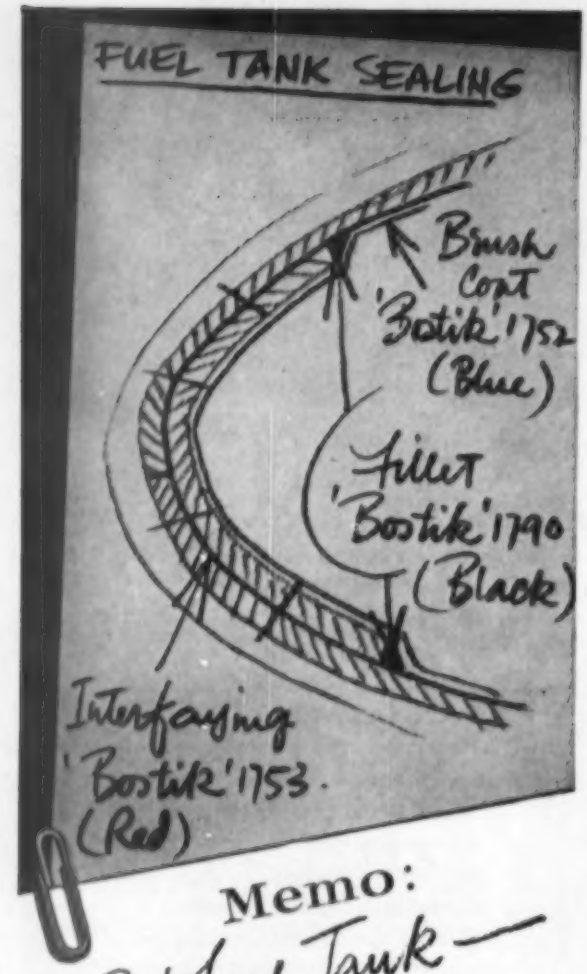

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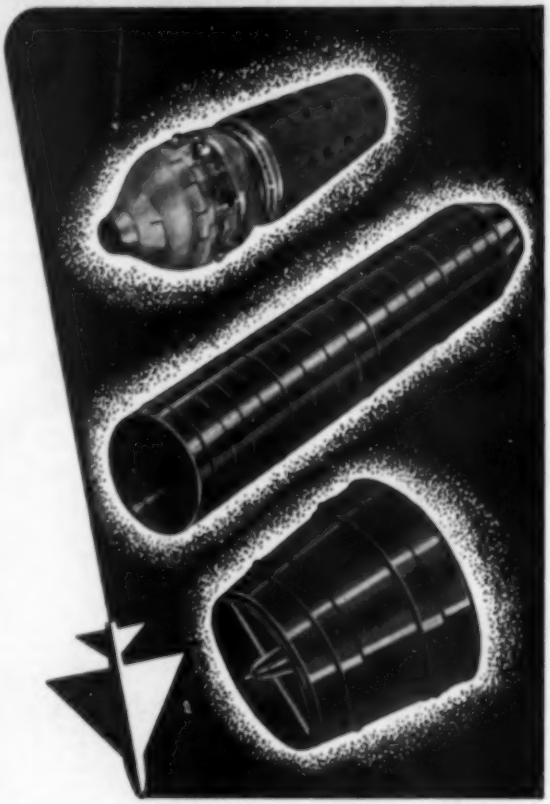

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Civil Aviation

I.A.T.A. REVIEWS THE SCENE

THE fact that air navigation aids and the ground organization of air transport are not keeping pace with the development of aircraft has been increasingly felt during the past few years. The matter was given considerable attention by the Technical Committee of I.A.T.A. at the tenth anniversary general meeting at New York last month. The following is a brief summary of the committee's report to the member airlines:—

Ground facilities are lagging behind the development of aircraft by about five years. "The figures [for the economics of new airliners] which have been given to you are all based—quite reasonably—on the assumption that these aircraft will be operated in the most effective manner which is technically possible," the report says. "Unfortunately, we who have that technical responsibility know that there are very few, if any, international air routes in the world today where the standard of air navigation facilities and services will permit us to perform our part of the overall operation efficiently and economically. The need to carry excessive fuel loads, delays in departure, slow handling due to inadequate terminal facilities, inefficient routeing, or assignment to uneconomic altitudes due to inflexible air control, excessive flight time resulting from inadequate and delayed meteorological information and inefficient communications—all these are problems which we are forced to live with today."

Estimating the total cost of one hour's non-productive flying of one modern aircraft as $1,000, the committee said that: "Airline financial losses due to inadequate facilities and services are serious, even with present-day aircraft and traffic densities. Unless the effectiveness of these facilities and services is improved such losses will be greater in the future with more expensive aircraft and greatly increased air traffic densities."

Approach and Landing. The "urgent and pre-eminent need," the report declared, "is to see what can be done to improve threshold and runway lighting. The aircraft itself has a major influence on the approach and landing problem, and a number of qualities are desired in future aircraft to ease the pilot's task during this most difficult phase of flight." Asserting that "we must turn to aircraft manufacturers for design improvements," the report said that "I.A.T.A. has already given them guidance on certain improvements we would like to see." The report also declared that, "we are disappointed with the lack of progress to date on FIDO" and that therefore "there is little hope of finding a positive answer to the question of whether it is operationally and economically feasible for air transport."

I.F.R. and V.F.R. Criteria. The I.A.T.A. report dealt at length with the need for revision of the criteria which determine whether a pilot must fly I.F.R. or V.F.R. Present criteria, established many years ago, "were quite adequate in the days when all aeroplanes flew at speeds of less than 200 m.p.h. Searching inquiries by I.A.T.A. have shown that "the ultimate solution can only lie in the full control of all air traffic at all times." The I.A.T.A. recommendation is that the visibility and distance-from-cloud criteria which determine which rules apply should be enlarged so as to give a pilot flying an aircraft at 300 m.p.h. a theoretical period of half a minute to see other aircraft.

Meteorology. The report warned that the present procedures for feeding weather data to aircraft in flight will be becoming outmoded by very-long-range aircraft: "5,000 to 6,000 mile flights will be commonplace before long." Changes in procedures "are already overdue," the report said, and I.A.T.A. are to propose to I.C.A.O. and the World Meteorological Organization less complicated procedures which will satisfy the requirements of long-range flights and remain compatible with short-range operations.

Communications. "Wherever you look," the report commented, "you will find that the Morse key of radio telegraphy is fast becoming obsolete and will soon be a museum curio. The preferred communications medium is now the spoken word of radio telephony, and there are now extremely few segments of our world-wide route networks on which it is not possible for an airliner captain to be in voice communication at all times with the ground." I.A.T.A. is attempting to attain universal R/T. standardization.

Navigation Aids. The report stated that controversy in the United States over the merits of the new TACAN system of short-range navigation as opposed to the established V.O.R. system has had unfortunate international repercussions because it has caused many countries to discontinue or slow down their V.O.R. programmes. It therefore reiterated the airlines' view that it will be at least ten to 20 years before international operational requirements will necessitate replacement of V.O.R. and urged that governments fulfil the I.C.A.O. regional plans for V.O.R. networks at the earliest possible moment. While it considered that the TACAN/V.O.R. dispute is primarily a domestic matter, the committee pointed out that TACAN is as yet operationally unproven and must go through a decade or more of test and development before it can be fully applied to air transport.

In long-distance navigation, the committee reported, airlines are showing a great deal of interest in an entirely new system known as Inertial Navigation; it is entirely self-contained in the aircraft and independent of the ground. Discussion of this system has not been possible until recently because of security, "but it is now being watched closely by the airlines because of its potential independence from extensive networks of ground stations."

Airborne Radar. Reports of advantages gained from airborne radar equipment by some airlines provoked a warning against "the belief that the black box of mysterious radar is the nostrum of all navigation and safety ills. Radar, like all engineering devices produced by man, has its limitations which must be carefully assessed before any particular design is integrated into the operational picture." As an example of the "wrong type of radar thinking," the report cited suggestions that if radar can be used to detect and avoid in-flight turbulence, the safety requirements for airframe primary structure could be relaxed.

Maintenance and Overhaul. "What we want for established and responsible airlines is that the state, instead of issuing a multiplicity of licences to individuals, will approve the airline's maintenance and overhaul facilities as a unit, on the basis of the airline's having satisfied the authority of the competence of its supervisory staff and specialists to act as a team in maintaining its aircraft in airworthy condition."

Aircraft Noise. The I.A.T.A. committee said that the airlines are devoting continuous research to ways and means of reducing noise. Operating techniques including steep take-offs and approaches with low power settings, preferential runway systems, etc., offer considerable promise. "Technical solutions, such as the use of engine exhaust mufflers, have been found to be relatively ineffectual."

Helicopters. I.A.T.A. Helicopter Meetings during the past year have worked out international agreements in principle on a number of basic points, including the practical size of heliports in built-up areas, obstruction clearance slopes, operational requirements for navigational aids and communications facilities and the like. Asserting that consideration of helicopter air traffic control and of navigation and communications facilities have gone hand in hand, the report stated that helicopter traffic control is following the superhighway system for automobile traffic.

I.C.A.O. Technical Assistance. The I.A.T.A. report paid tribute to the I.C.A.O. Technical Assistance Programme which it predicted will have a considerable impact on the future development of air transport. Designed to assist states whose resources cannot fully meet the needs of civil aviation, it has greatly helped to get facilities installed and services operating.

Future I.A.T.A. Plans. The Committee announced that the next I.A.T.A. Conference will be held in Italy in the spring of next year and will have as its major topic of consideration "the present and future problems of terminal and en route air traffic control in areas of high traffic density."

TRANSPORT LUNCHEON

A BUOYANT good humour pervaded the 36th anniversary luncheon of the Institute of Transport at the Connaught Rooms in London on November 9th.

The new president, Mr. Peter Masefield, recalled a recent conversation with a prominent member of the American air transport business who had told him that he knew about the Speedboid and the Lennox-Boyd, but wanted to know what sort of boid was this Carpenter. (Later Mr. Boyd-Carpenter suggested that the motto of the present Government should be "Jobs for the Boyds.")

Mr. Masefield remarked on the $650 million orders placed in recent weeks for 110 American aircraft, and observed wistfully that one British airline was still awaiting treasury approval for "more modest expenditures."

Mr. Boyd-Carpenter welcomed the happy situation in the aircraft industry, with the former chief executive of B.E.A. making aeroplanes for B.O.A.C. and the former deputy chairman of B.O.A.C. making engines for B.E.A. This he considered to be a process of rationalization which should produce a situation wherein everybody knew the answers for both sides.

Sir William Hildred, Director-General of I.A.T.A., alluded to "a certain inevitability about the air," with more and more being carried farther and farther, faster and faster, oftener and oftener, and asked for appropriate capital. He wished to know where were the great proconsuls of the air, and suggested that operators should spend less time cutting into each other's markets.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Further Command Changes

FOLLOWING the appointment of Air Marshal Sir Dermot Boyle as Chief of the Air Staff (as reported in *Flight* on November 4th) it is now announced that his place as A.O.C.-in-C. Fighter Command will be taken in the middle of next year by Air Marshal Sir Thomas G. Pike, K.C.B., C.B.E., D.F.C. During the time between the departure of Sir Dermot Boyle and the arrival of his successor, A.V-M. H. L. Patch, now commanding No. 11 Group, will take over Fighter Command with the acting rank of air marshal. His place in No. 11 Group will be taken by A. Cdre. V. S. Bowling with the acting rank of air vice-marshal.

It is also announced that Air Marshal Sir Brian Reynolds will be appointed A.O.C-in-C. Coastal Command next April in succession to Air Chief Marshal Sir John Boothman, who is being placed on the retired list. This post carries with it the NATO commands of CINCMAIRCHAN and CINCMAIREASTLANT.

A.V-M. D. Macfadyen will be appointed A.O.C-in-C. Home Command next March with the rank of air marshal, in succession to Air Marshal Sir Harold Lydford, who is being placed on the retired list.

Air Marshal Sir Thomas Pike has been D.C.A.S. since the latter half of 1953. Before that he had been Deputy Chief of Staff (Operations) of AAFCE and A.C.A.S. (Policy) at Air Ministry. During the war he commanded No. 219 Sqn., was twice awarded the D.F.C. and became S.A.S.O. of the Desert Air Force.

Air Marshal Sir Bryan Reynolds has been A.O.C. Malta, G.C., and previously commanded groups in Technical Training and Home Commands, and was S.A.S.O. Northern Ireland. During the war he commanded Coastal Command stations in Scotland, the Faroes and Devonshire and became S.A.S.O. of No. 247 Group, Azores, and No. 222 Group, Ceylon.

A.V-M. Douglas Macfadyen relinquished the post of A.O.C. British Forces, Aden, in 1953 to become Commandant of the Staff College at Bracknell. He commanded a squadron in France at the beginning of the war and later commanded bomber stations at home before taking up staff duties in the Mediterranean.

Air Marshal Sir Thomas Pike, A.O.C.-in-C designate of Fighter Command.

A. Cdre. V. S. Bowling has commanded the Northern Fighter Sector since April last year. He was previously S.A.S.O. at Air H.Q. Iraq, and A.O.C. Cyprus. He served in the Middle East and then commanded fighter stations in England during the war.

Supersonic Bale-out

WHEN his Hunter failed to respond to the controls in a very-high-speed dive off the coast of East Anglia recently, F/O. H. Molland ejected at a speed thought to be in the region of Mach 1.1. The height was about 25,000ft. He fell into the sea and was picked up almost immediately by a target-towing launch. It was found that he had suffered a broken arm, two black eyes and a fractured pelvis. His crash helmet, watch, gloves and one shoe were blown off during ejection. The parachute opened automatically at about 10,000ft and speed of descent was normal. Molland was unable, because of his injuries, to inflate his dinghy in the water. He is thought to be the second man ever to have baled out successfully at such a speed; the first was an American.

S. of S. has Trouble

THE Hastings carrying the Secretary of State for Air from Woomera to Melbourne during his Australian visit landed at its destination in gale-force winds with the starboard inner engine feathered. An airscrew fault was the cause of the trouble.

Sudan Withdrawal

ACCORDING to the terms of the Anglo-Egyptian agreement, the R.A.F. units have completed their withdrawal from Khartoum in the Sudan. The operation ended a little ahead of schedule.

Pay Packets

PAY is being issued in sealed packets as an experiment at several R.A.F. stations. No conclusion has yet been reached as to whether this method should be adopted as standard practice.

Taranto Anniversary

THE fifteenth anniversary of the Fleet Air Arm's attack on Taranto was celebrated last Friday at Lee-on-Solent at a dinner attended by the Duke of Edinburgh.

All Clear

IN a written reply to a question in Parliament recently, Mr. George Ward, Parliamentary Under-Secretary for Air, stated that cosmic rays presented no hazard to crews flying on R.A.F. operations. Service medical authorities were, however, watching this problem in the light of information received from a number of sources, including data from balloons.

Fast and capable of long endurance, the Vickers-Supermarine Swift F.R.5 (Avon) is now going into service with fighter reconnaissance units of 2nd T.A.F. Standard are an afterburner, moving tail-plane, clear-vision canopy, saw-tooth leading edge, large ventral fuel tank, two 30 mm Aden guns and a battery of cameras. The gun-camera is now housed in the nose-wheel door and a metal "doll's eye" cover protects the glass window in front of the camera in the extreme nose. Provision is made for externally carried weapons.

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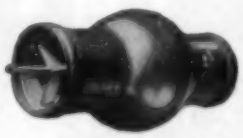

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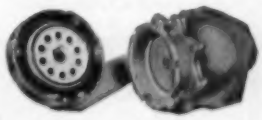

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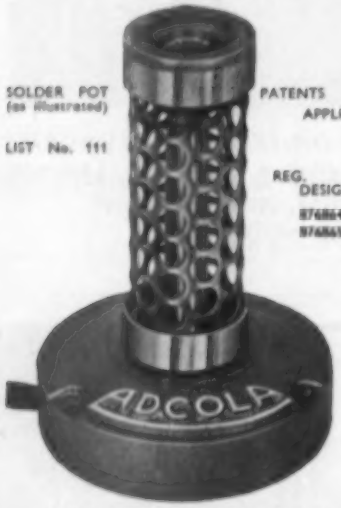

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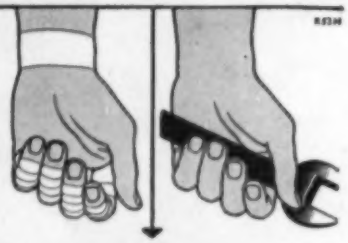

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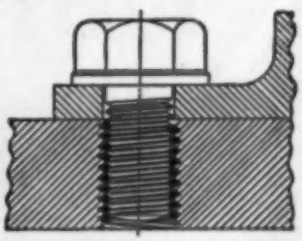

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Weybridge Works, Weybridge, Surrey

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Vacancies exist for Technical Assistants between the ages of 20 and 30, for analysis of flight test data. Previous experience of this type of work would be an advantage and preference will be given to applicants with H.N.C. or degrees and knowledge of aerodynamics.

Write stating full particulars to **Staff Officer, Handley Page Ltd., Cricklewood, London, N.W.2.**

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:

FROM Air Charter, Ltd., of 15, Great Cumberland Place, London, W.1, for the following Seasonal Normal Scheduled Services to be operated with Bristol 170 aircraft for the carriage of day return passengers at a frequency of 10 return flights weekly, increasing further subject to demand, during the season from 1st April to 15 October inclusive each year for a period of seven years, commencing 1st April, 1956:

APPLICATION No. 575. For a service between Southend and Ostend.

APPLICATION No. 576. For a service between Southend and Le Touquet.

APPLICATION No. 577. For a service between Southend and Calais (March).

APPLICATION No. 680. From Eagle Aviation, Ltd., of 29, Clarges Street, London, W.1, for a Seasonal Inclusive Tour Service to be operated with Viking aircraft in conjunction with Co-operative Travel Service (C.W.S. Ltd.) for the carriage of passengers and supplementary freight between London (Blackbushe) and Pisa (San Guiste) at an initial frequency of one return flight weekly, to be operated on Mondays, during the season from May to October inclusive each year for a period of seven years, commencing 1st May, 1956.

APPLICATION No. 681. From Air Kruise (Kent), Ltd., of 1, Great Cumberland Place, London, W.1, for a Seasonal Inclusive Tour Service to be operated with Dakota aircraft in conjunction with Golden Coach Tours, Ltd., for the carriage of passengers between Lydd and Palma at a frequency of one return flight fortnightly, to be operated on Sundays during the season from April to October inclusive each year for a period of seven years, commencing April, 1956.

APPLICATION No. 9/4. From Don Everall Aviation, Ltd., of Elmdon Airport, Birmingham, for permission to use Dakota aircraft throughout the period of approval in addition to the D.H.89A aircraft already authorised on their U.K. Internal Services from Birmingham, Coventry and Leicester to the Channel Islands and from Birmingham, Coventry and Leicester to the Isle of Wight (Applications Nos 9 and 454) which the Company have been approved to operate until 1959 and 1961 respectively.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations of objections.

THE Air Transport Advisory Council also give notice that the following application has now been withdrawn:

APPLICATION No. 641. From Dan-Air Services, Ltd., of Bilbao House, 36/38, New Broad Street, London, E.C.2, for an Inclusive Tour Service in conjunction with Lissone Linderman (London), Ltd., between London (Blackbushe) and Cologne. This application was advertised in "The Times," "The Aeroplane" and "Flight" on 7th October, 1955. [4498

AVRO AIRCRAFT LIMITED

TORONTO · ONTARIO CANADA

Require Staff in the following categories, and applications are invited from men contemplating emigration to Ontario, Canada.

DESIGN DRAFTING

With a minimum of three years' industrial design experience preferably on airframe, but similar or associated experience on mechanical equipment or light structures is acceptable. Applicants should possess Ordinary or Higher National Certificate.

LAYOUT DRAFTING

With a minimum of three years' drafting experience, either

(a) On full-scale layout work or

(b) As a detail draughtsman capable of breaking down from main structural assemblies or

(c) As a draughtsman with template layout experience, capable of carrying out production modification on full-scale layouts.

These positions carry excellent salaries, vocations with pay, and full participation in the Company's new non-contributory Group Health Insurance Plan for employees and their dependents, covering hospital, medical and surgical benefits.

The Company also operates a contributory Pension Plan after qualifying period of two years' service.

Successful applicants will receive assistance towards cost of transportation of themselves and dependents.

Personal interviews and engagement will be arranged in the United Kingdom.

Applicants should write or call for application form to:—

DEPARTMENT A.5., AVRO AIRCRAFT LIMITED 12 New Burlington Street, London, W.1.

The Company has also vacancies for
STRESS ENGINEERS
AERODYNAMICISTS
MECHANICAL TEST ENGINEERS
and
FLIGHT TEST ENGINEERS
and applications from Engineers in these groups should also be directed to above address.

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SENIOR DRAUGHTSMEN

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in the following divisions at its Mitcham Factory:—

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In each field of work vacancies exist in the Production Development and Technical Departments.

Applications are invited from persons holding the General Certificate of Education at Ordinary level in science subjects and at Advanced level, and others who possess either the Ordinary or Higher National Certificate in Electrical Engineering.

The posts give an opportunity for further training in the electronics field and there are facilities for further study leading to higher qualifications. There are, in addition, considerable opportunities for promotion in varying and expanding fields of electronic work.

Commencing salaries will be according to age, experience and qualifications and can be considered as progressive. There is a Company Pension Scheme and Long Service Holiday Plan.

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THE PERSONNEL OFFICER, THE MULLARD RADIO VALVE CO., LTD.,
NEW ROAD, MITCHAM JUNCTION, SURREY

quoting reference JFG/TECH/GEN.

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Manufacturers of Aircraft and Motor Equipment offer progressive positions to fully qualified

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MECHANICAL ENGINEERS

The work is in connection with research and development of advanced gas turbine equipment.

Graduates preferred but applicants with wide industrial experience would be considered.

★ *High salaries paid to the right men.*
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Applications giving details of experience and quoting Ref. LDO/JF.10 should be addressed to: THE PERSONNEL MANAGER,
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Rotax Ltd.

have a number of vacancies for

SENIOR SWITCHGEAR DESIGNERS

of creative ability in the design of new types of switchgear for important military and civil aircraft projects.

Previous experience in the design of aircraft circuit breakers, contactors and electro-mechanical devices is desirable, though not essential, and permanent positions are offered to candidates who have acquired a sound technical background in the engineering industry. The location of the work may be at Willesden or at Hemel Hempstead to suit applicants.

Apply in the first instance to:—

THE CHIEF ENGINEER, ROTAX LTD., CHASE ROAD, WILLESDEN, N.W.10

TECHNICAL STAFF REQUIRED FOR GUIDED WEAPONS WORK IN AUSTRALIA

A number of positions exist for Engineers and Technicians in the Australian Division of Sir W. G. Armstrong Whitworth Aircraft Ltd. All these positions carry attractive salaries and successful applicants will be eligible for a superannuation scheme. Passages to Australia for applicants and their families will be provided and assistance will be given in obtaining housing.

Engineers. Max. age 40 years. Should be graduates in Electrical or Mechanical engineering and have experience in the aircraft or G.W. fields.

Technicians. Max. age 35 years. Should have H.N.C. or equivalent in Mechanical or Electrical engineering and have experience in the aircraft or G.W. fields.

Applications should be made to the

Staff Employment Officer,
Sir W. G. Armstrong Whitworth Aircraft, Ltd.
Whitley, Nr. Coventry.

MARSHALL

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Vacancies also exist for many other branches of technical work. Particular interest will be shown in applications from Associate Fellows of the Royal Aeronautical Society.

Applications, quoting date and prefix letter of advertisement to:—
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THE DE HAVILLAND ENGINE COMPANY LIMITED

require

TECHNICAL ASSISTANTS

to fill a limited number of vacancies in their

NEW OFFICES IN CENTRAL LONDON

Excellent prospects for men with experience in the stressing of gas turbine engines.

GOOD SALARY

Applications, stating age, qualifications and experience should be addressed to:—

The Personnel Officer,
The de Havilland Engine Company, Limited,
Stag Lane, Edgware, Middlesex.

SAUNDERS-ROE

LIMITED

require

Senior, Intermediate and Junior

DRAUGHTSMEN
STRESS ENGINEERS
AERODYNAMICISTS

and other Technicians at their London, Eastleigh and Osborne, I.o.W. design offices.

Applications will be welcomed from experienced technicians who are keen to join an expanding organisation engaged on interesting and important projects of an advanced nature.

Assistance with accommodation can be given to those selected for work at Osborne.

Interviews may be arranged in London and in other centres.

Please send brief particulars (quoting ref. F/52) to the **Personnel Officer, Saunders-Roe Limited, East Cowes, I.o.W.**

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SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

A full and interesting programme of advanced design work is being undertaken by our

LONDON DESIGN DEPARTMENT

at York House.

ADDITIONAL accommodation has been acquired to permit a considerable increase in staff during the next six months and applications from enterprising Draughtsmen, Stressmen and Weights Engineers will be welcome.

NUMEROUS advantages can be offered to those joining this expanding organisation, including good prospects of promotion, really worthwhile salaries, and the opportunity to become a member of an enthusiastic and friendly group.

APPLICATIONS, giving details of age, experience, etc., and quoting reference F/46, should be addressed to the Personnel Officer.

SAUNDERS-ROE LIMITED, York House, Queen Square, W.C.1. (Week-end interviews will be arranged in London.) [4403

DEVELOPMENT ENGINEERS AND PHYSICISTS

APPLICATIONS are invited from Development Engineers and Physicists to fill a vacancy in the laboratories of Louis Newmark, Ltd., for work on the development of electromagnetic devices principally for incorporation in aircraft instruments and equipment. A degree or similar qualification is considered essential, and some previous laboratory or engineering industrial experience in any field desirable. The position carries considerable responsibility and offers plenty of opportunity for advancement. Applicants should be of British nationality. Pension scheme. Please apply in writing giving full particulars to: Personnel Officer, Louis Newmark, Ltd., Prefect Works, Purley Way, Croydon. [4500

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required for design and development work on novel aircraft components with special emphasis on hydraulic equipment. Essential qualifications: technical education to Degree standard; wide experience in high grade precision engineering, preferably but not necessarily including hydraulic equipment; initiative; ability to lead in team. Appropriate salary. Good conditions. Pension scheme. Apply with full details of experience and indication of salary requirements to:
Personnel Manager,
SPERRY GYROSCOPE CO., LTD.,
Great West Road,
Brentford,
Middx. [4449

TECHNICAL ASSISTANT

required for development work on new materials and processes. Applicants must have had a good engineering background with some ability in the preparation of working drawings and preferably had some experience in the aircraft industry. This post will provide adequate scope for a keen man with initiative.

Written applications (in complete confidence) giving concise details of age, qualifications and experience, in the first instance to:
The Personnel Manager,
BLACKBURN & GENERAL AIRCRAFT, LTD.,
Brough, E. Yorks.
Mark envelopes: "Development." [4416

PILOT wanted, experienced, endorsed Dove, Rapide. Senr. Comm. Lic. with instrument rating. Good pay and allowances. North-west England. Box No. 7647. [4496

SITUATIONS VACANT

TWO TECHNICAL ASSISTANTS

are required for stability, control and general theoretical investigations in the advanced Project Section of our London Design Office.

THE necessary qualifications comprise a Degree or its equivalent in science or engineering. Previous experience desirable but not essential.

APPLICATIONS to:

BLACKBURN & GENERAL AIRCRAFT LTD.,
63 Old Brompton Road,
London, S.W.7.

marking envelopes "Project" in top left hand corner. [4446

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WEAPONS RESEARCH DIVISION WOODFORD, CHESHIRE

VACANCIES exist in the Airframe Design Department for Flutter Technicians.

APPLICANTS should possess a degree in engineering or mathematics or hold an equivalent qualification with a good mathematical background. Aircraft or missile experience is desirable but not essential.

APPLY: The Chief Engineer, A. V. Roe & Co., Ltd., Weapons Research Division, Woodford, Cheshire. [4477

HONG KONG AIRCRAFT ENGINEERING COMPANY LIMITED

REQUIRE the services of Aircraft Engineers licensed categories A. and C. preferably endorsed Constellation 749. Apply N. W. Crouchet, Manager, Australian National Airways Pty., Ltd., 5 Lower Regent Street, London. [4474

ELECTRICAL Engineer with "X" Licence required for the overhaul of Dove/Dakota equipment. Permanent position with prospects offered.

APPLY to Chief Engineer, Cambrian Airways, Ltd., Cardiff Airport, nr. Barry, Glamorgan. Tel.: Barry 2160. [4467

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FOUR positions in the Main Engine Development Department. Applicants must have a Degree or H.N.C. Salary range £600-£800 dependent on qualifications and experience. Two positions in the Defect Investigations Department. Salary range £750-£900 dependent on experience.

INSURANCE and superannuation schemes together with excellent welfare considerations. Application quoting MEX/D1, Technical Personnel Officer, Box 7798. [4442

A WELL-KNOWN aircraft company is able to offer attractive positions to Draughtsmen (all grades) in their London Design Office.

APPLICATIONS will be welcomed from:—

(i) Draughtsmen with experience of the design of aircraft structures, systems, etc.
(ii) Draughtsmen who wish to transfer to this type of work.

AMONG the advantages which can be offered are:—

(a) Good salaries.
(b) Increases according to individual merit.
(c) Excellent working conditions in pleasant surroundings.
(d) Interesting work with a friendly team.

ALL relevant details, e.g., age, experience, salary, should be forwarded to Dept. LD/7, Box 3J C 2463, A.K. Advg., 212a Shaftesbury Avenue, London, W.C.2. [4490

SAUNDERS-ROE LIMITED have vacancies for Junior Technicians in their Design Organization at Osborne, I.o.W.

APPLICANTS should have completed their National Service and be of Higher National Certificate standard.

EXPERIENCE of aircraft design would be an advantage. Assistance with housing accommodation may be offered. Good conditions, pension scheme, etc.

SEND details of age, experience, etc., and present salary to the Personnel Officer, Saunders-Roe Limited, East Cowes, I.o.W. (Please quote ref. F/55.) [4492

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APPLICATIONS, giving full details of age, experience, etc., and quoting ref. F/53, should be forwarded to the Personnel Officer, Saunders-Roe Limited, East Cowes, I.o.W. [4493

AIR Charter Company, Blackbushe, operating large four-engine aircraft, invites applications for the post of Chief Engineer. Apply in confidence to Box 7567. [4479

SITUATIONS VACANT

ANY Senior Aerodynamicist of drive and ability who would like to discuss the details of an unusual opportunity, offering considerable scope and wide interest, should write to the address below.

AT this stage, only a brief outline of qualifications, experience, age and salary is necessary. This will be treated in strict confidence.

INTERVIEWS will be arranged at which details of the available position may be discussed.

BOX 3J C 2477.

A.K. Advg., 212a Shaftesbury Ave., London, W.C.2. [4491

AERODYNAMICISTS capable of taking a position of leading responsibility in the High Speed Section of the Design Department at Osborne are invited to write without delay to the address below.

THE selected applicant will work on a progressive programme of supersonic designs, interesting special projects and associated physics and engineering problems. He will have technical qualifications to Higher Degree standard and adequate applied experience.

AN attractive salary, good prospects, assistance with housing and participation in assurance and pension schemes are among the advantages which can be offered.

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TEST and Laboratory Engineers required for gyro and electro mechanical instruments. Apply stating age, experience and salary required to S. G. Brown, Ltd., Shakespeare Street, Watford, Herts. [0147

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SMITHS AIRCRAFT INSTRUMENTS, LTD., have a vacancy in their Technical Sales editing office for a keen man of good education, preferably with aviation engineering background and ability to handle technical correspondence and enquiries with customers. Apply: Ref. SSE/PLI, Cricklewood Works, London, N.W.2. [4473

SITUATIONS VACANT

ADEN AIRWAYS (Asmara), Arab Airways (Amman) and British International Airlines (Kuwait) require pilots. Captains (A.L.T.P.) Group I Dakota. First Officers (commercial and senior commercial, Group I or II Dakotas and Vikings). Apply Staff Manager, A.B.A.(ME), Ltd., Stratton House, Stratton Street, London, W.1. [4478

ROCKETS. Manufacturers of Rocket Propulsion Engines have two vacancies for Mechanical Engineers for the design of test equipment. Applicants must have a Degree or H.N.C. Salary £700-£850 depending on experience. Three vacancies for Electronic Engineers. Applicants must have at least a H.N.C. Salary £600-£750. Applications quoting ME/EL/R to Box 7399. [4444

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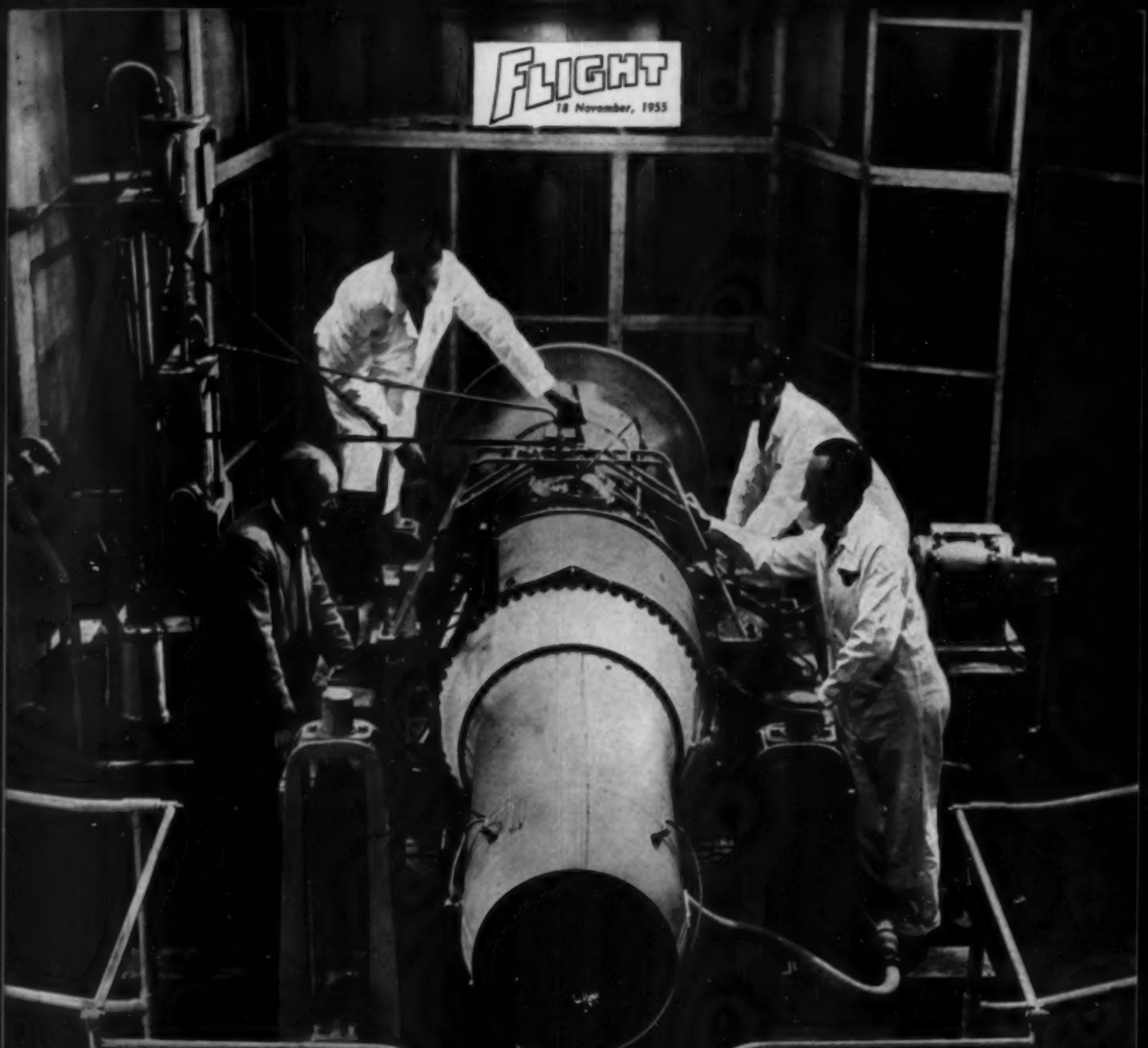

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